SCIENTIFIC AMERICAN SUPPLEMENT. No 1298

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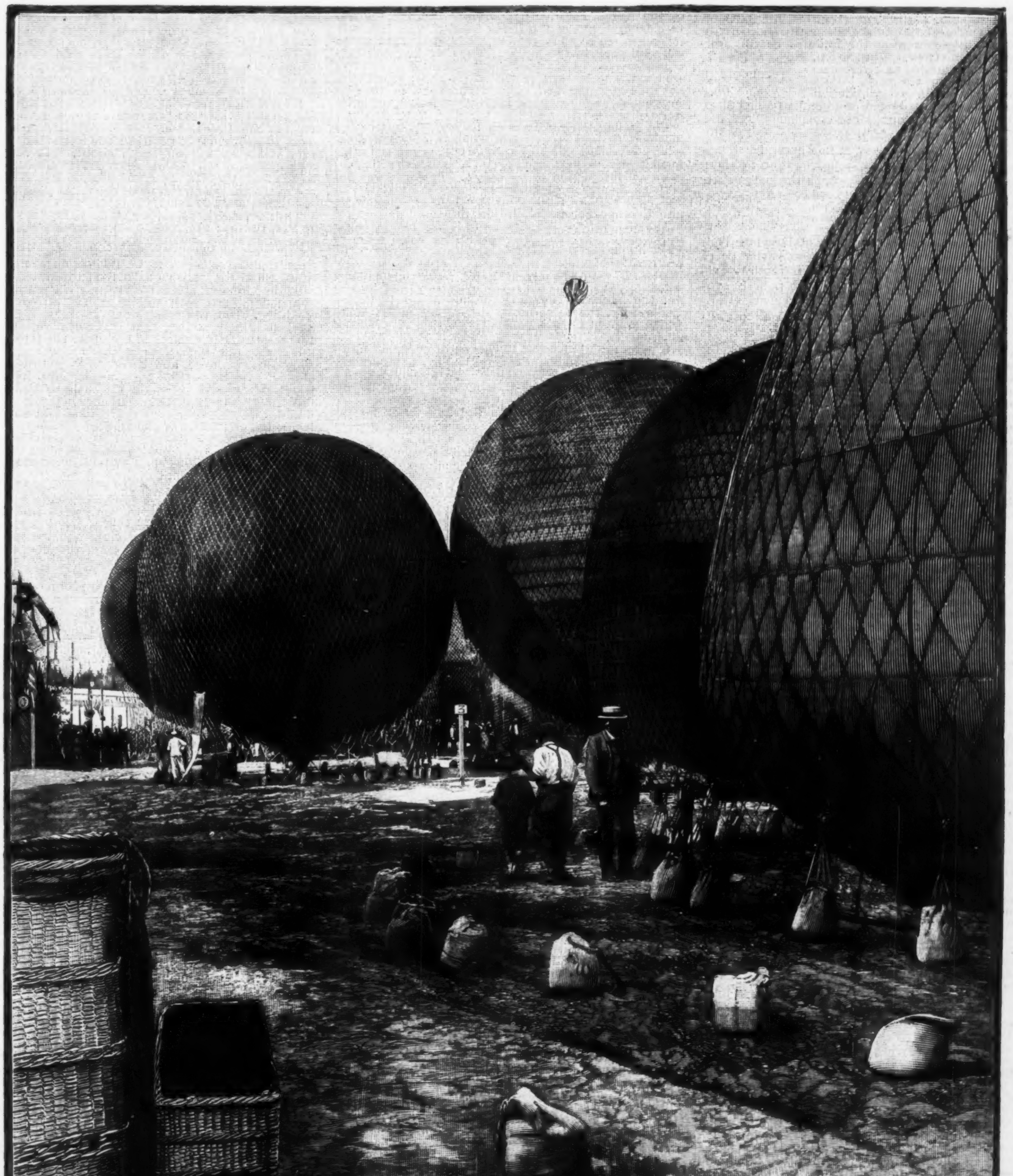
Scientific American, established 1845. Scientific American Supplement. Vol. L. No. 1298.

NEW YORK, NOVEMBER 17, 1900.

Scientific American Supplement. $5 a year. Scientific American and Supplement. $7 a year.



BALLOONS EXHIBITED AT THE VINCENNES ANNEX OF THE PARIS EXPOSITION.

THE BALLOON IN MODERN WARFARE.

WHEN Napoleon, in 1798, disbanded the airship division which had participated, not without success and glory, in the engagements of the French armies with the allied powers, the military balloon sank gradually into oblivion. It was not until the French successfully employed the balloon during the siege of Paris (1870 to 1871) in communicating with the outer world that the possibilities of aerial navigation dawned upon military officers. France almost immediately began the organization of an airship division. The astonishing success of the airship "La France" induced the other European powers to follow the example of their Gallic rival.

There originated three distinct types of military balloons and wagon-parks. The European armies have, for the most part, followed England in inflating the gas-bags with hydrogen, transported under great pressure in steel tanks. The balloons employed differ in size, form, and structure; the wagon-parks in size and mobility.

The French airship park is well equipped with gas-holders; but the vehicles employed for transportation are heavy and awkward. The varnished-silk balloons of 500 cubic meters capacity are admirably constructed and technically perfected to the minutest detail. Our engraving, taken from L'Illustration, shows a French balloon park, exhibited at Vincennes.

The English airship park, consisting of but few vehicles, is exceedingly mobile and simple. The balloons, made of animal gut, are not half as large as those of the other armies. The great mobility and simplicity of the English parks are obtained only at the cost of efficiency.

The German airship park, heavy though it be, is sufficiently mobile to meet all requirements. The balloons are made of gummed cotton in either the well-known globular form or kite-form. They are somewhat heavy and lack the elegance of appearance characteristic of French balloons; they are, however, very efficient, and are particularly serviceable in stormy weather.

Since the experience obtained in actual warfare is as yet hardly of sufficient value to demonstrate the value of the balloon as an instrument in a modern European war, we are more or less thrown upon the results obtained in the great annual maneuvers of the European armies.

It has been objected that the balloon is a most admirable means of indicating to the enemy the position of the army by whom it has been sent up. But the objection falls to the ground when it is considered that a mighty army of the twentieth century would hardly be able to approach within a day's march of the enemy without being observed. Moreover, an ascending balloon would indicate the position of but a small body of men. The strength and organization of an entire force could hardly be disclosed. But whatever may be the disadvantages incurred by thus betraying the position of a small body of its men, the invaluable information gleaned by means of the balloon will more than compensate for these disadvantages.

It has, furthermore, been objected that the balloon, being but the plaything of the wind, the instruments of precision could not be used effectively, and that an observer could not collect data of sufficient accuracy. But the improvements made in the so-called kite-balloons (Drachenballons) of the Germans show that the objection is no longer tenable. The ordinary globular balloon can hardly be used to advantage in even a moderate wind. The kite-balloon, on the other hand, can be used three hundred days in the year. No modern steam or electrical military appliance operates under all conditions; still it is depended upon in times of emergency. As a general rule the efficiency of the balloon is greatly overestimated. Years of experience have shown that a height of 500 meters (1,640 feet) is not sufficient for all observations, for which reason the height has been doubled. But even at an elevation of 1,000 meters (3,280 feet) the balloon is not safe from modern high-power guns. The observer is, therefore, compelled to study the enemy at so respectful a distance that he cannot always collect the data desired. The value of balloon photography is also much overrated. While the art of telephotography is still in so undeveloped a state that only long exposures can be made, photography by means of captive balloons will be of small service, for the reason that with ordinary apparatus serviceable pictures taken at distances of three and five miles are the exception rather than the rule. Only in siege warfare has photography, up to the present time, proved of any value.

The chief obstacle encountered in the use of the balloon in modern warfare is the rapid generation of hydrogen gas in light, portable apparatus.

After years of experiment Renard devised a portable gas-producer which it was thought solved the problem, and was, therefore, adopted by the French army. Renard's experiments were not accepted as conclusive either by Germany or England. In the French system a mixture of water and sulphuric acid was pumped into a vessel containing scraps of zinc or iron. In the German process, on the other hand, shells or receptacles filled with lime and pulverized zinc were heated in a portable retort furnace to generate hydrogen gas. The French method was the quicker, but was dependent upon a supply of water and necessitated the transportation of a steam-pump and heavy chemicals. The German method, on the other hand, although not so rapid, could be employed under all conditions. The shells or receptacles were readily transportable. But both processes were not very well adapted for field use, because the minimum time for the inflation of a balloon was three hours.

When the English army resorted to the plan of transporting the compressed gas in steel tanks and successfully filled its balloons in a remarkably short time, not only in sham-battles but also in actual warfare in the Soudan, it was felt that the obstacle was at last overcome. Germany and France soon organized new airship parks modeled after those of the English army. The change was altogether for the better. The cumbrous gas-producers were discarded and in their stead light steel tanks employed, with the result not only that the gas-bags could be more quickly inflated, but that the parks could move more readily from place to place. Whether or no the balloon can be disabled by well-directed fire is a question which has been settled with reasonable certainty. It has been found by actual tests that shrapnel fire alone is to be feared, that field-pieces have not always sufficient elevation to bring down a captive balloon, and that heavy guns (5 and 6 inch) are effective against balloons at a distance of four miles.

Dirigible airships are still so crude that their importance in warfare can hardly as yet be gaged.

[Continued from SUPPLEMENT, No. 1297, page 20797.]

THE MODERN SYSTEM OF TEACHING PRACTICAL INORGANIC CHEMISTRY AND ITS DEVELOPMENT.*

WHEN it is considered how slowly experimental work came to be recognized as a means of illustration and education, even in connection with lectures, it is not surprising that in early times practical teaching in laboratories should have been thought quite unnecessary.

The few laboratories which existed in the sixteenth century were built mainly for the practice of alchemy by the reigning princes of the time, and, indeed, up to the beginning of the nineteenth century, the private laboratories of the great masters were the only schools in which a favored few might study, but which were not open to the public. Thus we find that Berzelius received in his laboratory a limited number of students who worked mostly at research; these were not usually young men, and his school cannot thus be considered as a teaching institution in the ordinary sense of the word.

The earliest laboratory open for general instruction in Great Britain was that of Thomas Thomson, who, after graduating in Edinburgh in 1799, began lecturing in that city in 1800, and opened a laboratory for the practical instruction of his pupils. Thomson was appointed lecturer in chemistry in Glasgow University in 1807, and regius professor in 1818, and in Glasgow he also opened a general laboratory.

The first really great advance in laboratory teaching is due to Liebig, who, after working for some years in Paris under Gay-Lussac, was appointed in 1824 to be professor of chemistry in Giessen. Liebig was strongly impressed with the necessity for public institutions where any student could study chemistry, and to him fell the honor of founding the world-famed Giessen Laboratory, the first public institution in Germany which brought practical chemistry within the reach of all students.

Giessen rapidly became the center of chemical interest in Germany, and students flocked to the laboratory in such numbers as to necessitate the development of a systematic course of practical chemistry, and in this way a scheme of teaching was devised which, as we shall see later, has served as the foundation for the system of practical chemistry in use at the present day.

When the success of this laboratory had been clearly established, many other towns discovered the necessity for similar institutions, and in a comparatively short time every university in Germany possessed a chemical laboratory. The teaching of practical chemistry in other countries was, however, of very slow growth; in France, for example, Wurtz in 1869 drew attention to the fact that there was at that time only one laboratory which could compare with the German laboratories, namely, that of the Ecole normale supérieure.

In this country the provision of suitable laboratories for the study of chemistry seems to date from the year 1845, when the College of Chemistry was founded in London, an institution which, under A. W. Hofmann's guidance, rapidly rose to such a prominent position.

In 1851 Frankland was appointed to the chair of chemistry in the new college founded in Manchester by the trustees of John Owens, and here he equipped a laboratory for the teaching of practical chemistry. Under Sir Henry Roscoe this laboratory soon became too small for the growing number of chemical students, a defect which was removed when the new buildings of the college were opened in 1873. In 1849 Alexander Williamson was appointed professor of practical chemistry at University College, London, where he introduced the practical methods of Liebig.

Following these examples, the older universities gradually came to see the necessity for providing accommodation for the practical teaching of chemistry, with the result that well-equipped laboratories have been erected in all the centers of learning in this country.

Since Liebig, by the establishment of the Giessen Laboratory, must be looked upon as the pioneer in the development of practical laboratory teaching, it will be interesting to endeavor to obtain some idea of the methods which he used in the training of the students who attended his laboratory in Giessen. From small beginnings he gradually introduced a systematic course of practical chemistry, and a careful comparison shows that this was similar in many ways to that in use at the present day. The student at Giessen, after preparing the more important gases, was carefully trained in qualitative and quantitative analysis; he was then required to make a large number of preparations, after which he engaged in original research.

Although there is, as far as I have been able to ascertain, no printed record of the nature of the quantitative work and the preparations which Liebig required from his students, the course of qualitative analysis is easily followed, owing to the existence of a most interesting book published for the use of the Giessen students.

In 1846, at Liebig's request, Henry Will, Ph.D., Extraordinary Professor of Chemistry in the University of Giessen, wrote a small book, for use at Giessen, called "Giessen Outlines of Analysis," which shows clearly the kind of instruction given in that laboratory at the time in so far as qualitative analysis is concerned. This book, which contains a preface by Liebig, is particularly interesting on account of the fact that it is evidently the first Introduction to Analysis intended for the training of elementary students which was ever published. In the preface Liebig writes: "The want of an introduction to chemical analysis adapted for the use of a laboratory has given rise to the present work, which contains an accurate description of the course I have followed in my laboratory with great advantage for twenty-five years. It has been prepared at my request by Prof. Will, who has been my assistant during a great part of this period."

This book undoubtedly had a considerable circulation, and was used in most of the laboratories which were in existence at that time, and thus we find, for example, that the English translation, which Liebig "hopes and believes will be acceptable to the English public," was the book used by Hofmann for his students at the College of Chemistry. In this book the metals are first divided into groups much in the same way as is done now; each group is then separately dealt with, the principal characteristics of the metals of the group are noted and their reactions studied. Those tests which are useful in the detection of each metal are particularly emphasized, and the reasons given for selecting certain of them as of special value for the purposes of separating one metal from another.

Throughout this section of the book there are frequent discussions as to the possible methods of the separation, not only of the metals of one group, but of those belonging to different groups; and the whole subject is treated in a manner which shows clearly that Liebig's great object was to make the student think for himself. After studying in a similar manner the behavior of the principal acids with reagents, the student is introduced to a course of qualitative analysis comprising (1) preliminary examination of solids, (2) qualitative analysis of the substance in solution.

Both sections are evidently written with the object, not only of constructing a system of qualitative analysis, but more particularly of clearly leading the student to argue out for himself the methods of separation which he will ultimately adopt. The book concludes with a few tables which differ considerably in design from those in use at the present day, and which are so meager that the student could not possibly have used them mechanically.

The system introduced in this book, no doubt owing to the excellent results obtained by its use, was rapidly recognized as the standard method of teaching analysis in most of the institutions existing at that time. Soon the course began to be further developed, book after book was published on the subject, and gradually the teaching of qualitative analysis assumed the shape and form with which we are all so well acquainted. But the present-day book on qualitative analysis differs widely from "Giessen Outlines" in this respect, that whereas in the latter the tables introduced are mere indications of the methods of separation to be employed, and are of such a nature that the student who did not think for himself must have been constantly in difficulties, in the book of the present day these tables have been worked out to the minutest detail. Every contingency is provided for; nothing is left to the originality of the student; and that which, no doubt, was once an excellent course has now become so hopelessly mechanical as to make it doubtful whether it retains anything of its former educational value.

The question which I now wish to consider more particularly is whether the system of training chemists which is at present adopted, with little variation, in our colleges and universities is a really satisfactory one, and whether it supplies the student with the kind of knowledge which will be of the most value to him in his future career.

Those who study chemistry may be roughly divided as to their future careers into two groups—those who become teachers and those who become technical chemists. Now, whether the student takes up either one or the other career, I think that it is clear that the objects to be aimed at in training him are to give him a sound knowledge of his subject, and especially to so arrange his studies as to bring out in every possible way his capacity for original thought.

A teacher who has no originality will hardly be successful, even though he may possess a very wide knowledge of what has already been done in the past. He will have little enthusiasm for his subject, and will continue to teach on the lines laid down by the text books of the day, without himself materially improving the existing methods, and, above all, he will be unable, and will have no desire, to add to our store of knowledge by original investigation.

It is in the power of almost every teacher to do some research work, and it seems probable that the reason why more is not done by teachers is because the importance of research work was not sufficiently insisted on, and their original faculty was not sufficiently trained, at the schools and colleges where they received their education.

And these remarks apply with equal force to the student who subsequently becomes a technical chemist.

In the chemical works of to-day sound knowledge is essential, but originality is an even more important matter. A technical chemist without originality can scarcely rise to a responsible position in a large works; whereas a chemist who is capable of constantly improving the processes in operation, and of adding new methods to those in use, becomes so valuable that he can command his own terms.

Now, this being so, I think it is extraordinary that so many of the students who go through the prescribed course of training—say for the Bachelor of Science degree—not only show no originality themselves, but seem also to have no desire at the conclusion of their studies to engage in original investigation under the supervision of the teacher. That this is so is certainly my experience as a teacher examiner, and I feel sure that many other teachers will indorse this view of the case.

If we inquire into the reason for this deficiency in originality, we shall, I think, be forced to conclude that it is in a large measure due to the conditions of study and the nature of the courses through which the student is obliged to pass.

A well-devised system of quantitative analysis is undoubtedly valuable in teaching the student accurate manipulation, but it has always seemed to me that the long course of qualitative analysis which is usually considered necessary, and which generally precedes the quantitative work, is not the most satisfactory training for a student.

There can be no doubt that to many students qualitative analysis is little more than a mechanical exercise. The tables of separation are learnt by heart and

* Opening address by Prof. W. H. Perkin, Jr., Ph.D., F.R.S., President of the Section of Chemistry, British Association.

every substance is treated in precisely the same manner; such a course is surely not calculated to develop any original faculty which the student may possess. Then, again, when the student passes on to quantitative analysis, he receives elaborate instructions as to the little details he must observe in order to get an accurate result; and even after he has become familiar with the simpler determinations he rarely attempts, and indeed has no time to attempt, anything of the nature of an original investigation in qualitative or quantitative analysis. It indeed sometimes happens that a student at the end of his second year has never prepared a pure substance, and is often utterly ignorant of the methods employed in the separation of substances by crystallization; he has never conducted a distillation, and has no idea how to investigate the nature and amounts of substances formed in chemical reactions; practically all his time has been taken up with analysis. That this is not the way to teach chemistry was certainly the opinion of Liebig, and in support of this I quote a paragraph bearing on the subject which occurs in a very interesting book on "Justus von Liebig: his Life and Work," written by W. A. Shenstone, pp. 175, 176:

"In his practical teaching Liebig laid great stress on the producing of chemical preparations; on the students preparing, that is to say, pure substances in good quantity from crude materials. The importance of this was, even in Liebig's time, often overlooked; and it was, he tells us, more common to find a man who could make a good analysis than to find one who could produce a pure preparation in the most judicious way.

"There is no better way of making one's self acquainted with the properties of a substance than by first producing it from the raw material, then converting it into its compounds, and so becoming acquainted with them. By the study of ordinary analysis one does not learn how to use the important methods of crystallization, fractional distillation, nor acquire any considerable experience in the proper use of solvents. In short, one does not, as Liebig said, become a chemist."

One reason why the present system of training chemists has persisted so long is no doubt because it is a very convenient system; it is easily taught, does not require expensive apparatus, and, above all, it lends itself admirably for the purpose of competitive examination.

The system of examination which has been developed during the last twenty years has done much harm, and is a source of great difficulty to any conscientious teacher who is possessed of originality, and is desirous, particularly in special cases, of leaving the beaten track.

In our colleges and universities most of the students work for some definite examination—frequently for the Bachelor of Science degree—either at their own university or at the University of London.

For such degrees a perfectly definite course is prescribed and must be followed, because the questions which the candidate will have to answer at his examination are based on a syllabus which is either published or is known by precedent to be required. The course which the teacher is obliged to teach is thus placed beyond his individual power of alteration, except in minor details, and originality in the teacher is thereby discouraged; he knows that all students must face the same examination, and he must urge the backward man through exactly the same course as his more talented neighbor.

In almost all examinations salts or mixtures of salts are given for qualitative analysis. "Determine the constituents of the simple salt A and of the mixture B" is a favorite examination formula; and as some practical work of this sort is sure to be set, the teacher knows that he must contrive to get one and all of his students into a condition to enable them to answer such questions.

If, then, one considers the great amount of work which is required from the present day student, it is not surprising that every aid to rapid preparation for examination should be accepted with delight by the teacher; and thus it comes about that tables are elaborated in every detail, not only for qualitative analysis in inorganic chemistry, but, what is far worse, for the detection of some arbitrary selection of organic substances which may be set in the syllabus for the examination. I question whether any really competent teacher will be found to recommend this system as one of educational value or calculated to bring out and train the faculty of original thought in students.

If, then, the present system is so unsatisfactory, it will naturally be asked, How are students to be trained, and how are they to be examined so as to find out the extent of the knowledge of their subject which they have acquired?

In dealing with the first part of the question—that is, the training best suited to chemists—I can, of course, only give my own views on the subject—views which, no doubt, may differ much from those of many of the teachers present at this meeting. The objects to be attained are, in my opinion, to give the student a sufficient knowledge of the broad facts of chemistry, and at the same time so to arrange his practical work in particular as to always have in view the training of his faculty of original thought.

I think it will be conceded that any student, if he is to make his mark in chemistry by original work, must ultimately specialize in some branch of the subject. It may be possible for some great minds to do valuable original work in more than one branch of chemistry, but these are the exceptions; and as time goes on and the mass of facts accumulates, this will become more and more impossible. Now a student at the commencement of his career rarely knows which branch of the subject will fascinate him most, and I think, therefore, that it is necessary, in the first place, to do all that is possible to give him a thorough grounding in all branches of the subject. In my opinion the student is taken over too much ground in the lecture courses of the present day; in inorganic chemistry, for example, the study of the rare metals and their reactions might be dispensed with, as well as many of the more difficult chapters of physical chemistry, and in organic chemistry such complicated problems as the constitutions of uric acid and the members of the camphor and terpene series, etc., might well be left out. As matters stand now, instruction must be given on these subjects simply because questions bearing on them will probably be asked at the examination.

And here, perhaps, I might make a confession, in which I do not ask my fellow teachers to join me. My name is often attached to chemistry papers which I should be sorry to have to answer; and it seems to me the standard of examination papers, and especially of Honors examination papers, is far too high. Should we demand a pitch of knowledge which our own experience tells us cannot be maintained for long?

In dealing with the question of teaching practical chemistry, it may be hoped, in the first place, that in the near future a sound training will be given in elementary science in most schools, very much on the lines which I mentioned in the first part of this address. The student will then be in a fit state to undergo a thoroughly satisfactory course of training in inorganic chemistry during his first two years at college. Without wishing in any way to map out a definite course, I may be allowed to suggest that instead of much of the usual qualitative and quantitative analysis, practical exercises similar to the following will be found to be of much greater educational value.

1. The careful experimental demonstration of the fundamental laws of chemistry and physical chemistry.

2. The preparation of a series of compounds of the more important metals, either from their more common ores or from the metals themselves. With the aid of the compounds thus prepared the reactions of the metals might be studied and the similarities and differences between the different metals then carefully noted.

3. A course in which the student should investigate in certain selected cases: (a) the conditions under which action takes place; (b) the nature of the products formed; (c) the yield obtained. If he were then to proceed to prepare each product in a state of purity, he would be doing a series of exercises of the highest educational value.

4. The determination of the combining weights of some of the more important metals. This is in most cases comparatively simple, as the determination of the combining weights of selected metals can be very accurately carried out by measuring the hydrogen evolved when an acid acts upon them.

Many other exercises of a similar nature will readily suggest themselves, and, in arranging the course, every effort should be made to induce the student to consult original papers, and to avoid as far as possible any tendency to mere mechanical work.

The exact nature of such a course must, however, necessarily be left very much in the hands of the teacher, and the details will no doubt require much consideration; but I feel sure that a course of practical inorganic chemistry could be constructed which, while teaching all the important facts which it is necessary for the student to know, will, at the same time, constantly tend to develop his faculty of original thought.

Supposing such a course were adopted (and the experiment is well worth trying), there still remains the problem of how the student who had this kind of training is to be examined.

With regard to his theoretical work there would be no difficulty, as the examination could be conducted on much the same lines as at the present time. In the case of the practical examination I have long felt that the only satisfactory method of arriving at the value of a student's practical knowledge is by the inspection of the work which he has done during the whole of his course of study, and not by depending on the results of one or two days' set examination. I think that most examiners will agree with me that the present system of examination in practical chemistry is highly unsatisfactory. This is, perhaps, not so apparent in the case of the qualitative analysis of the usual simple salt or mixture; but when the student has to do a quantitative exercise, or when a problem is set, the results sent in are frequently no indication of the value of the student's practical work. Leaving out of the question the possibility of the student being in indifferent health during the short period of the practical examination, it not infrequently happens that he, in his excitement, has the misfortune to upset a beaker when his quantitative determination is nearly finished, and as a result he loses far more marks than he should do for so simple an accident.

Again, in attacking a problem he has usually only time to try one method of solution, and if this does not yield satisfactory results he again loses marks; whereas in the ordinary course of his practical work, if he were to find that the first method was faulty, he would try other methods until he ultimately arrived at the desired result.

It is difficult to see why such an unsatisfactory system as this might not be replaced by one of inspection, which I think could easily be so arranged as to work well.

A student taking, say, a three years' course for the degree of Bachelor of Science, might be required to keep very careful notes of all the practical work which he does during this course, and in order to avoid fraud his notebook could from time to time be initialed by the professor or demonstrator in charge of the laboratory. An inspection of these notebooks could then be made at suitable times by the examiners for the degree, by which means a very good idea would be obtained of the scope of the work which the student has been engaged in, and if thought necessary a few questions could easily be asked in regard to the work so presented. Should the examiners wish to further test the candidate by giving him an examination, I submit that it would be much better to set him some exercise of the nature of a simple original investigation, and to allow him two or three weeks to carry this out, than to depend on the hurried work of two or three days.

The object which I had in view in writing this address was to call attention to the fact that our present system of training in chemistry does not appear to develop in the student the power of conducting original research, and at the same time to endeavor to suggest some means by which a more satisfactory state of things might be brought about. I have not been able, within the limits of this address, to consider the conditions of study during the third year of the student's career at college, or to discuss the increasing necessity for extending that course and insisting on the student carrying out an adequate original investigation before granting him a degree, but I hope on some future occasion to have the opportunity of returning to this very important part of the subject. If any of the suggestions I have made should prove to be of practical value, and should lead to the production of more original research by our students, I shall feel that a useful purpose has been served by bringing this matter before this section. In concluding I wish to thank Prof. H. B. Dixon, Prof. F. S. Kipping, and others, for many valuable suggestions, and my thanks are especially due to Dr. Bevan Lean for much information which he gave me in connection with that part of this address which deals with the teaching of chemistry in schools.

TRADE NOTES AND RECEIPTS.

Paste for Labels on Metals.—Powdered alum, 4·0; powdered borax, 4·0; hydrochloric acid, 22·5; wheat flour, 240·0; water, 360·0. Mix alum, borax and wheat flour together, stir the mixture with water; next add the hydrochloric acid and boil until the solution has taken place. If necessary the paste may be thinned with water.—Neueste Erfindungen und Erfahrungen.

Snow-White Dressing.—The following snow-white dressing is suitable for sail-cloth and buckskin shoes, as well as for ladies' and soldiers' belts:

Water	13·6	liters.
Fine pipe-clay	4·540	kilos.
Bleached shellac	1·360	"
Powdered borax	0·680	"
Soft soap	0·085	"
Ultramarine blue	0·056	"

Boil the shellac and the borax in water until completely dissolved, add soft soap, pipe clay and ultramarine, stir well and strain through a fine sieve.—Seifensieder Zeitung.

Utilization of the Lime Residues from Acetylene Apparatus.—The owner of an acetylene plant utilized his lime residue for the walls of an annex he built. Same is said to have been found excellent, its good utilizability being at once recognized by the building workmen, and there is now a great demand for it, especially since the owner can furnish the lime cheaper than the dealer in building materials of his town. Hence, this utilization of the lime residues from the acetylene apparatus, which are still frequently thrown away as worthless, can be recommended. But they will be eligible for the said purpose without any further treatment only if the decomposition of the carbide had been a complete one by plentiful excess of water. In the case of the above-mentioned plant the pure overflow system was used.—Zeitschrift für Calcium-Carbid und Acetylen Fabrikation.

Dustless Floor Oil.—Under this name various preparations have been introduced, of late, which are of a varying composition. The so-called dustless oils do not dry in consequence of the lack of siccatives, turpentine, etc., or other properties.

Following are some reliable receipts:

For drawing rooms, etc.:

White vaseline oil	600	parts.
Raw linseed oil	800	"
Patchouli oil	2 to 4	"

For offices, stores, factories, etc.:

a.	Yellow vaseline oil	1000	parts.
	Linseed oil	1000	"
b.	Rape seed oil	1000	"
	Linseed oil	1500	"
c.	Yellow vaseline oil	1000	"
	Rape seed oil	500	"
	Linseed oil	2000	"

Although the so-called dustless floor oil does, of course, not create a perfectly dustless room, yet the dust is reduced to a minimum.

A drawback presented by the above oils is that any articles falling down are apt to be soiled or ruined.—Pharmaceutische Zeitung.

Milch's Dyeing Process for Tropical Suits.—On the occasion of the equipment of the troops of the East Asiatic corps, special attention was paid to the brown color of the ticking suits which is said to be of particular value as a protective color in the country.

That this is actually so, is fully demonstrated by the tests which have been instituted by the German navy. In order to have a concealing color for the white worksuits of the disembarking corps, which, resembling the sand of the tropics, affords to the soldier a better protection than the white color visible at a long distance, the Imperial naval office has proposed the problem to find a process which would dye the suits similar to the tropical sand, remaining permanent in rain and surf, but removable by water and soap without chemical ingredients.

The apothecary Milch, of the naval station at Wilhelmshaven, has succeeded in solving this important problem. He started from the correct standpoint that only vegetable substances could possess the desired qualities and that, if possible, they had to be such dyestuffs as could be had everywhere.

He invented the following process:

Boil 4 grammes of chicory in 15 liters of sea water in a kettle; strain, rinse the straining cloth with 10 liters of hot water and admix to this extract, after cooling, 400 grammes of a chlorophyl solution prepared by his own method. If the dyeing is to proceed quickly, digest the chicory with 25 liters of hot water for about one-half hour and then add the chlorophyl solution. Into this greenish gray emulsion the suits are laid for twenty to thirty minutes, kneading through well, wringing out and hanging to dry. If there is a great hurry, the wrung-out suits may be put on at once.

For the purpose of cleaning the suits again, they are first rinsed with clear water, then washed two or three times, according to the kind of texture, with white neutral soap, so-called "navy soap," in cold water. This manipulation is sufficient to remove all dyestuffs and to restore the suits to a faultless whiteness.

In case of emergency, the dyestuff can be prepared wherever there are vegetable substances containing chlorophyl. If chicory is absent, roasted coffee may be substituted therefor.—Pharmaceutische Centralhalle.

THE PARALLELOGRAM OF MOTIONS.

By Prof. C. W. MACCORD, Sc.D.

THE "parallelogram of motions" is a graphic construction for determining the actual motion of a point, or material particle, to which are imparted, at the same instant, two motions in different directions. Thus, in Fig. 1, if one impulse imparts to the point A a motion in the direction $A\,x$, of which the velocity is represented by $A\,B$, and at the same instant another impulse imparts to it the motion $A\,C$ in the direction $A\,y$, then, according to the doctrine under consideration, the resultant of these components will be a motion represented in direction and in velocity by the diagonal $A\,D$ of the parallelogram $B\,C$. And conversely, if the actual motion $A\,D$ had been assigned, a reversal of the process would have resolved it into the components $A\,B$ and $A\,C$, in any directions $A\,x$ and $A\,y$ chosen at pleasure.

This is of course familiar to all our readers, it obviously has numerous applications in the graphic analysis of mechanical movements, and, since the motion of a point at any instant is the tangent to its path, it renders service to pure mathematics in the employment of Roberval's Method of Drawing Tangents.

But, whether regarded mechanically or mathematically, the determination of a motion is not of any value unless it is correct; and even if the two components are given, we shall presently see that notwithstanding the plausibility and elegant simplicity of the "parallelogram of motions," it is by no means to be taken for granted that its diagonal always truly represents the actual resultant motion, either in direction or in velocity.

As the first step in the demonstration of this hetero-

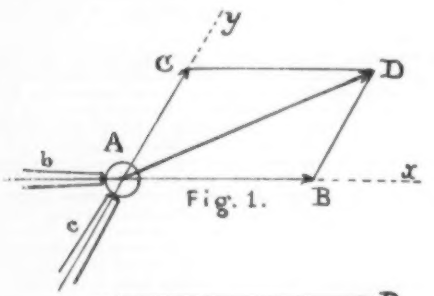


Fig. 1.

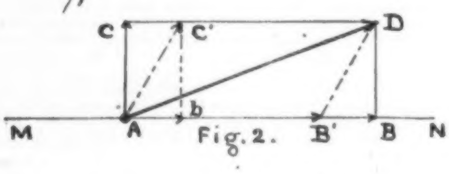


Fig. 2.

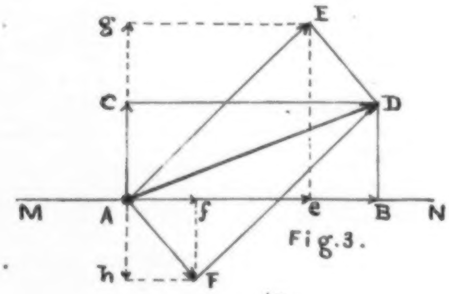


Fig. 3.

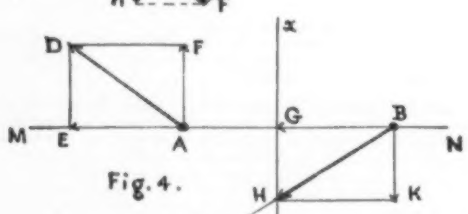


Fig. 4.

dox assertion, let the point A in the line $M\,N$, Fig. 2, have the motion represented by $A\,D$. Resolve this into the components $A\,B$ in the direction of $M\,N$, and $A\,C$ perpendicular to it: the former may be called the longitudinal component, and the latter the side component.

Now these two components always exist, no matter how the given motion $A\,D$ is resolved. Thus, in the same figure, it might have been resolved into $A\,B'$, $A\,C'$; but $A\,C'$ itself has a component $A\,b$ in the line $M\,N$, and $A\,b$ is equal to $B'\,B$, so that the total longitudinal component of $A\,D$ is $A\,B$, as before; and the side component is unchanged.

Again, in Fig. 3, suppose the motion $A\,D$ (which is the same as in Fig. 2) to be resolved into $A\,E$, $A\,F$. Then $A\,E$ has a longitudinal component $A\,e$ and a side component $A\,g$; also $A\,F$ has a longitudinal component $A\,f$ and a side component $A\,h$.

It is obvious on inspection that $A\,f$ is equal to $e\,B$, and lies in the same direction, so that the total longitudinal component in the direction $M\,N$ is $A\,e + A\,f$, which is equal to $A\,B$. It is also obvious that $C\,g$ is equal to $A\,h$; but these have opposite directions, so that the actual side component is $A\,g - C\,g$, or $A\,C$, as in the preceding figure; these rectangular components, $A\,B$ and $A\,C$, may then be appropriately termed absolute components in reference to the line $M\,N$.

Next, it is to be recollected that if two points be so connected that the distance between them cannot change, the motions of these points are subject to the condition that their absolute components along the right line joining them must be of the same magnitude, and lie in the same direction. Thus in Fig. 4, let A and B be two points of the rigid and inextensible bar represented by $M\,N$. To A we may assign any motion at pleasure, as $A\,D$ for example; this has a longitudinal component $A\,E$. And whatever the actual motion of the point B may be, its longitudinal component $D\,G$ must be equal to $A\,E$ and have the same direction. And because $B\,G$ is an absolute component, the other component must be at right angles with it; consequently the line representing the resultant motion of B must terminate in the indefinite line $x\,x$ perpendicular to $M\,N$. If then we desire the point B to move in a given direction, as $B\,y$ for instance, the intersection of $B\,y$ with $x\,x$ determines the magnitude of the resultant $B\,H$.

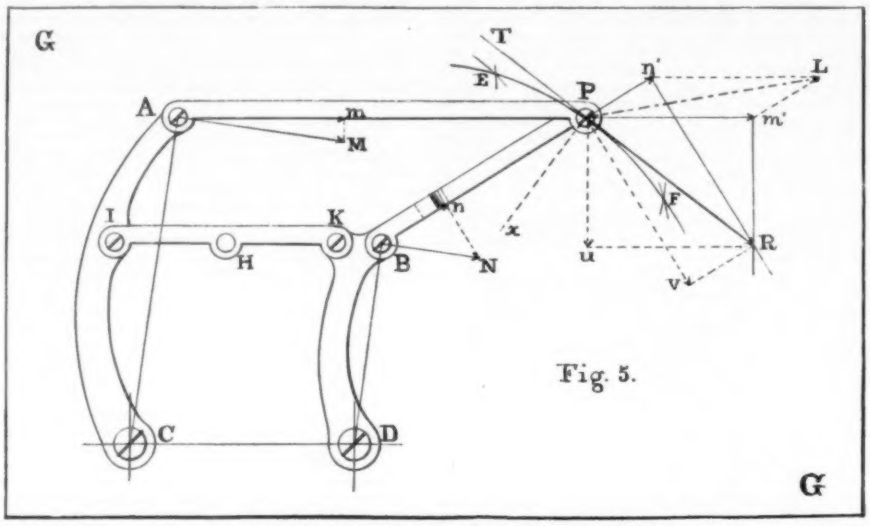


ILLUSTRATION OF A MODEL FOR DEMONSTRATING AN EXCEPTION TO THE PARALLELOGRAM OF MOTIONS.

The effect of assigning a given direction then, is to render the motion of B determinate. But this may be done otherwise, thus: suppose another line to pass through B cutting $M\,N$ at any angle, and suppose further that an absolute component along that line be found, just as $A\,E$ was found along the line $M\,N$; the problem then is, to ascertain the resultant motion of B from those two components. Clearly the preceding argument applies to the second component as well as to the first: and here we shall find the "diagonal of the parallelogram" a most unreliable guide. This is shown in a very striking manner by the aid of the model illustrated in Fig. 5, constructed by the writer for class-room demonstration. Two levers $A\,C$ and $B\,D$ turn upon pivots fixed at C and D in the baseboard $G\,G$; these levers are connected by the link $I\,K$ which for simplicity's sake is made equal and parallel to $C\,D$; and it has fixed in it a handle at H for moving the levers. Two other links are pivoted together at P, and one is pivoted to the right hand lever at B, the other being pivoted at A to the left hand lever. Now suppose the handle H to be moved to the right, in such a manner as to give A a motion $A\,M$ perpendicular to $A\,C$; then B will have a motion $B\,N$ perpendicular to $B\,D$.

The motion $A\,M$ has an absolute component $A\,m$ in the direction $A\,P$; m' the motion of P must therefore have a component $P\,m' = A\,m$. In like manner $B\,N$ has an absolute component $B\,n$ along $B\,P$, to which $P\,n'$ must be equal.

If, now, as one might be apt to do, we complete the parallelogram, the resultant motion of P would be the diagonal $P\,L$. But upon moving the handle H to the right, the point in question perversely moves in the direction $P\,R$. In doing so, it simply illustrates the demonstration above given in connection with Fig. 4; according to which, the true resultant must be determined by drawing at n' a perpendicular to $B\,P$, and at m' a perpendicular to $A\,P$, and finding their intersection R: then $P\,R$ represents, in both direction and velocity, the motion of P at the instant considered.

In fact, since $P\,m'$, $P\,n'$, are absolute components, it is clear that the resultant motion $P\,R$ must be the diagonal of the rectangle $m'\,u$, and also the diagonal of the rectangle $n'\,v$, which by this construction it is.

In explanation of the other lines shown in the figure, it is to be stated that after moving the handle H a certain distance to the left, arcs were struck with the new positions of A and B, with $A\,P$ and $B\,P$ as radii, thus determining the intersection E; in like manner the intersection F was determined after moving H a corresponding distance to the right.

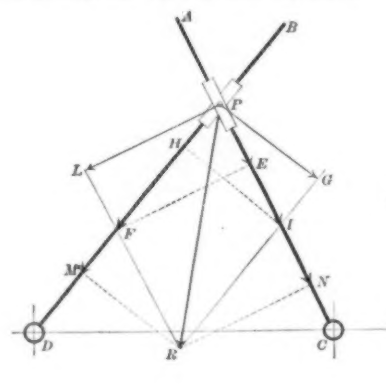


FIG. 6.

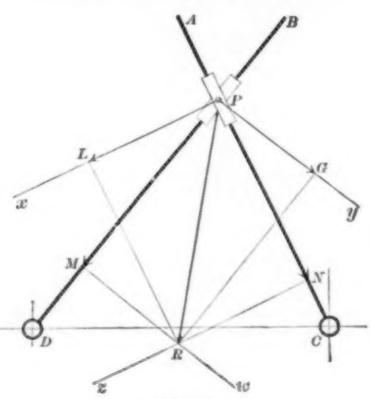


FIG. 7.

The center of the circle passing through the points E, P, and F was then found, and a radius drawn to P (of which $P\,x$ is a portion); and the fact that this radius proved to be perpendicular to $T\,P\,R$, which is the tangent at P to the path of that point, gave satisfactory evidence as to the accuracy of the construction.

Now reverting to Fig. 1, it will be seen that the doctrine of the parallelogram of motions assumes that A is a free point in space, able to obey not only the impulse which would impart to it the motion $A\,B$, but also the one which would impart to it the motion $A\,C$. As if A were a billiard ball, struck (but not pushed) at the same instant by the two cues b, c; in which case the resultant motion would certainly be $A\,D$ the diagonal of the parallelogram.

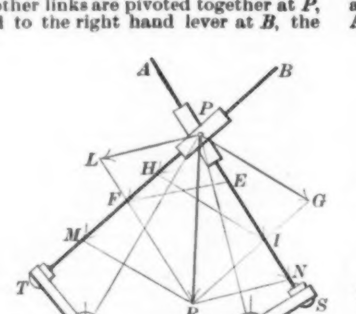


FIG. 8.

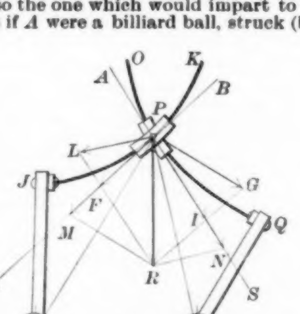


FIG. 9.

In Fig. 5, however, P is not a free point; it undeniably receives the two component motions $P\,m'$, $P\,n'$, but its motion is restricted by the conditions that it must always lie upon $A\,P$, at a fixed distance from A, and also upon $B\,P$, at a fixed distance from B: and A and B have determinate relative motions.

It may be added that the writer has had, at various times, friendly discussions with some who were at first

disposed to hold views at variance with the ones above set forth; but these discussions were always definitely settled by the exhibition of the model.

But this is not the only case in which the "diagonal of the parallelogram" fails to indicate correctly the resultant motion when two components are given.

In Fig. 6 let $A C$ and $B D$ represent steel rods which turn about fixed centers C and D, while at the same time they slide freely through two sleeves pivoted together at P. The action of this combination is best studied by first supposing one rod, as $A C$, to be held stationary, while the other turns. The point P of the latter must then at the instant move in a direction perpendicular to $B D$; and let its velocity be represented by $P G$. The pin connecting the sleeves must move absolutely in the direction $P C$, since the rod $A C$ now forms a fixed guide, along which the sleeve through which it passes is compelled to slide. The other sleeve however not only rotates about D, but can slide along the rod $B D$. Consequently the actual velocity $P I$ of the pin P is found by drawing through G a parallel to $B D$. Drawing $I H$ parallel to $P G$, we note that upon the above supposition, P moves in the direction $A C$ at the rate $P I$, and in the direction $B D$ at the rate $P H$.

Next, let $B D$ be held stationary, while the point P of the rod $A C$ moves in rotation about C with the velocity $P L$; then by similar reasoning the resultant motion of P will be $P F$ in the direction $B D$, of which the other component will be $P E$ in the direction $A C$.

Now, if both rods rotate at the same time with the velocities above assumed, the final resultant motion $P R$ is found by considering the partial resultants $P I$, $P F$ (which are entirely independent of each other) as components, completing the parallelogram and drawing the diagonal.

But it is to be observed that the total velocity of P in the direction $P C$ will be equal to $P E + P I$, and its velocity in the direction $P D$ will be $P H + P F$. And drawing $R N$ perpendicular to $A C$, and $R M$ perpendicular to $B D$, we have $I N = P E$, and $F M = P H$; so that $P N$, $P M$, are the velocities of P in the directions $A C$, $B D$, respectively.

Now $F R$, $I R$, are simply prolongations of $L F$ and $G I$, so that if the components of rotation are assigned, as $P L$ and $P G$, the resultant motion $P R$ may be at once determined by drawing perpendiculars to them at L and G, intersecting in R; then the total sliding components are found by drawing $R M$, $R N$, respectively perpendicular to $B D$, $A C$.

If then, as in Fig. 7, the components $P M$, $P N$, are assigned, the resultant is found, not by completing the parallelogram and drawing the diagonal, but by drawing $N z$, $M w$, respectively perpendicular to $A C$ and $B D$; these intersect in R, and $P R$ is the required resultant. And the components of rotation are found as easily, by drawing $P x$ perpendicular to $A C$, and $P y$ perpendicular to $B D$, upon which lines we let fall the perpendiculars $R L$, $R G$, from the point R.

Obviously, the problem here involved is that of determining the motion of the point of intersection of two straight lines which rotate about fixed centers—in this case these centers lie upon the lines themselves. In Fig. 8, the centers lie outside the lines; and the process is modified in the respect that while the components of rotation, $P L$ and $P G$, are perpendicular to $P C$ and $P D$, the partial resultants $P I$ and $P F$ must lie in the direction of the two rods $A S$, $B T$; and are found by drawing $G I$ parallel to $B T$, and $L F$ parallel to $A S$. The total resultant $P R$ is found as before by completing the parallelogram, and the rates of sliding along the rods, by drawing $R N$ perpendicular to $P C$, and $R M$ perpendicular to $P D$.

We are now enabled to make the problem still more general, and to determine the motion of the intersection of two curved lines. In Fig. 9 the steel rods are bent into the form of circular arcs, which slide through correspondingly curved sleeves pivoted together at P, and turn about the fixed centers C and D. Through P draw a tangent to each arc; for facility of comparison, the combination is purposely so drawn that these tangents are parallel to $A S$, $B T$ of Fig. 8, and that the points P, C, and D have the same relative positions as in that diagram.

Proceeding as before, we assign a rotative component to the point P on the arc $J K$, the right hand piece being held stationary. Then it will be at once seen that the first partial resultant $P I$ must have the direction of the tangent $P S$, while the corresponding sliding component must have the direction $P T$ along the tangent to the other arc.

Further explanation is needless, it being now quite apparent that the final resultant $P R$, and the total rates of sliding, $P M$ and $P N$, are determined precisely as in Fig. 8.

Going one step farther, it is to be remarked that the circular arcs $J K$, $O Q$, might be tangent at P to any two curves whatever, circular or otherwise; and supposing those curves rotate about C and D, the motion of P at the instant would not be in any way affected by the substitution. It is true that if the new curves are not circular, the device of the sliding sleeves can not be employed. But by this time it should be apparent that they are not at all necessary in any case, and that the motion of the point of intersection of the two lines, whether straight or curved, is determined by the rotations alone; still, these sleeves have been of service, by making evident to the eye the reasons for certain steps in the process of finding the resultant motion sought.

We have, then, two distinct cases in which the diagonal of the parallelogram does not give the true resultant, when two component motions of a point are assigned. In the first case, the point in question is a fixed point *of* each of two moving lines, that is, it cannot change its distance from any other point on either line.

In the second case, however, it is a point *on* each line, but free to change its position in relation to other points of both lines.

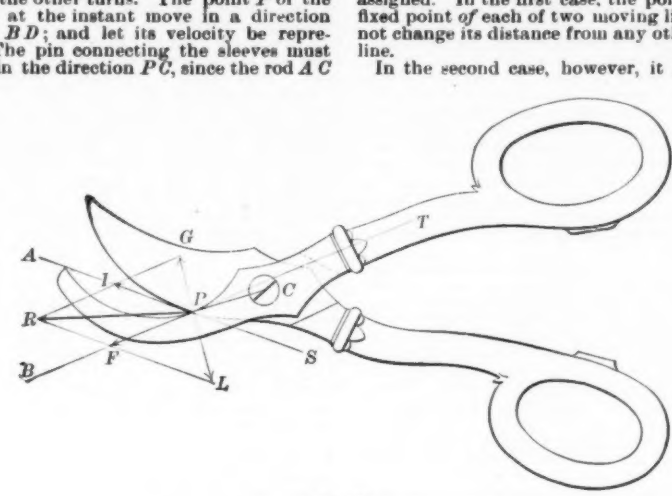


FIG. 10.

The former state of things is very frequently met with in mechanism, and the principle demonstrated in Fig. 5 has numerous applications in the graphic analysis of mechanical movements.

The second case is more rare, and its most extensive application will probably be in drawing tangents to curves by Roberval's method.

Still, a single instance will show that it may give a ready solution to a practical question; given the velocities of the blades of a common pair of shears, what is the rate of the shearing cut? The same question may be asked in relation to the pruning scissors with curved blades, shown in Fig. 10. Here C is the common center of rotation, $A S$ is tangent to the upper blade and $B T$ to the lower one, at their intersection P. Regarding C as fixed, let $P G$, $P L$ be the components of rotation, both of which are perpendicular to $P C$. As in Fig. 9, draw through G a parallel to $B T$, and through L a parallel to $A S$; these intersect in R, and $P R$ is the motion of the point of intersection. When the blades are straight, like those of the common shears, each edge is its own tangent, and the construction is made as in Fig. 8.

THE ARMORED CRUISER "JEANNE D'ARC."

THE "Jeanne d'Arc," which was successfully launched at Toulon on the 8th of June, belongs to the class of armored cruisers, and is in every respect superior to many of the vessels of this type which still figure upon the lists of modern fleets. Her armor is composed of plates of Harveyized steel, the force of resistance of which is much greater than that of the iron plates which protect very many of the armor-clads now in service. Her guns, which are of unusual power, are very efficient, as a consequence of the progress made in the manufacture of ordnance. Finally, the "Jeanne d'Arc" is a very swift vessel, and made 23 knots on her trial trip, say a little more than 25 miles an hour. Perhaps it will be regretted that an attempt has been made to obtain so great a speed, since this has certainly rendered it necessary to sacrifice many things and to surmount great difficulties, by reason of the immense space required by the engines and boilers that are always required in such a case.

This cruiser is not designed to form part of a squadron for war duty, but has a more modest mission, that of protecting maritime commerce, making raids in distant seas, and destroying the enemy's merchant vessels and swift packet boats. In order to do this a vessel must have a high speed, a sufficiently high power armament, and a wide radius of action, which is equivalent to saying that its coal supply must permit it to make long trips. To solve such a problem is not easy. Whether the "Jeanne d'Arc" will solve it, it remains for the future to say.

The armored cruiser is in great favor in all navies, and is now taking the place so long occupied by what are called protected cruisers, that is to say, those that are destitute of side armor. About twenty years ago the English constructed a group of five of these, but went no further in this direction. France, in turn, took up the work and produced an excellent ship, the "Dupuy de Lôme," which embodied most of the innovations that are now in general use. The "Dupuy de Lôme" was an admirable vessel, and it would have been necessary only to increase her size in order to improve the type. Her armor was a very prominent feature, and the artillery in turrets was perfectly protected; but the French waver in their ideas, and, instead of improving upon this specimen and giving a wider range of action, they reduced the tonnage, the protection, the speed, and the armament of the vessels that followed. This error led them to add to their navy five inadequate armored cruisers of about 5,000 tons, which are neither fleet ships nor ships for a squadron and which are now utilized in any way that may be found possible. With the "Jeanne d'Arc," France has taken a new departure and is now constructing twelve cruisers, some of 10,014 tons and others of 9,500 and 7,700, with a speed of 21 knots.

The "Jeanne d'Arc" has the following dimensions:

Length over all	477	feet.
Breadth	63·75	"
Mean draught	24·75	"
Displacement	11,270	tons.

As may be seen from the accompanying figures, she has two groups of three funnels, two protected conning towers and two masts. The foremast is provided with a military top equipped with 1½-inch rapid-fire guns, designed to repel the attacks of torpedo boats. The other mast is to be used only for signals.

The vessel has three screws, each driven by triple expansion vertical engine, each of which is completely isolated and independent of its neighbors. This is the "Dupuy de Lôme" system, now applied for the first time upon this vessel.

Steam is furnished to the cruiser's engines by tubular boilers of the Guyot type, and belonging to the general type of what are called multi-tubular or aqua-tubular generators, and the water in which passes through the interior of the tubes. The evaporating apparatus is to furnish 28,500 horse power, although a portion of this will be utilized for running the numerous—too numerous—auxiliary engines that operate upon the vessel. The modern ship is truly a huge workshop, in which the mechanic reigns as master.

For feeding the grates, it is possible to stow away upon the "Jeanne d'Arc" 2,100 tons of coal. This supply, increased by several hundred tons of petroleum, will permit of running 4,000 leagues at sea at the low speed of 10 knots; and so the "Jeanne d'Arc" will be able easily to make a trip to China without a stoppage. In order to protect her, there has been established, according to the French system, an armored belt formed of steel plates of 6-inch thickness that surround the entire loadwater line, and, above this, a thinner protected belt of 3-inch thickness. Finally,

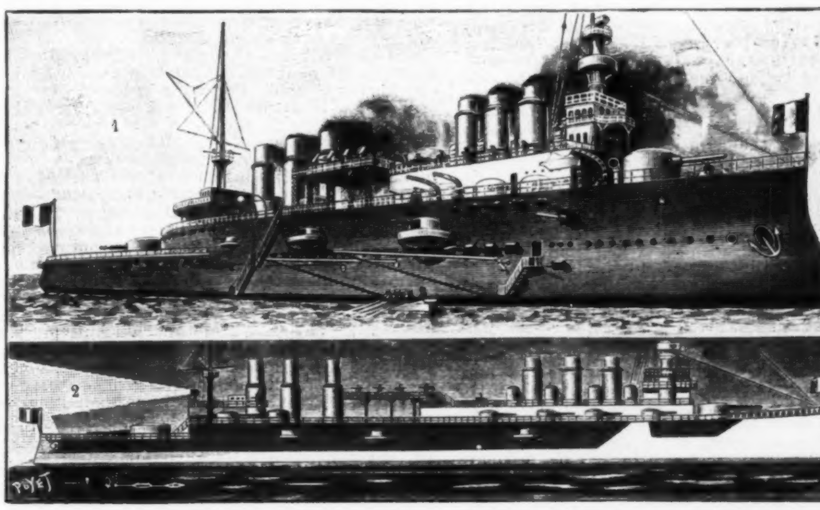


FIG. 1.—ARMORED CRUISER "JEANNE D'ARC."

1. General view. 2. View showing arrangement of the armor, which is represented in white.

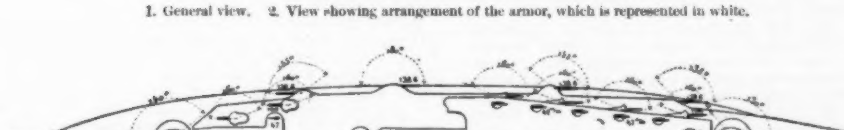


FIG 2.—RADIUS OF FIRE OF THE CRUISER'S GUNS.

the armor ascends toward the front, almost for a third of the length, starting from the stem, thins down to 2¼ inches, and covers the entire height of the hull. Such an arrangement has been devised because in a swift cruiser the front is the part that is most exposed to the fire of the enemy. The protection is completed by two armored decks.

Let us now pass to the ordnance. The armament is composed as follows: Two 7·6-inch guns in turrets; eight 5·6-inch guns in casemates or in sponsons; twelve 4-inch guns in turrets; sixteen 1·6-inch guns upon the bridges; eight 1·3-inch guns upon the upper deck and in the military top; and two submerged torpedo tubes. The turrets for the 7·6-inch and 4-inch guns are closed and protected with steel, as are also the casemates and sponsons. The small pieces are sheltered behind shields of hardened steel.

By reason of this distribution of her artillery, the "Jeanne d'Arc" presents three fine lines of fire: the first consisting of her 7·6 and 4-inch guns in turrets; the second of her 5·6-inch guns in protected casemates; and the third, dominating all, of her small 1·6 and 1·3-inch pieces.

Such is the armored cruiser "Jeanne d'Arc," which embodies every progress that has been made in the naval art, and in which electricity plays a leading role both for the driving of machines and external and internal lighting. Let us add that the vessel will cost a little more than twenty-one million francs. According to the Navy Department, she will not be available for service until toward the end of the year 1901.

For the above particulars and the illustrations, we are indebted to La Nature.

A CHINESE PHYSICIAN.

By the Hon. WILLIAM E. S. FALES, formerly United States and French Consul in Amoy, China.

MY first acquaintance in the medical profession of the Middle Kingdom was Ong Ah Chin Peh Tsai, popularly known as Ah Chin. He was about fifty years old, tall, slender and dignified. He belonged to the mandarin class, having taken the second, or Kyu-jin, degree. His medical knowledge was hereditary, if I may use a bull, his father, grandfather, and other ancestors having been members of the profession. With the curious instinct begotten by ancestor worship, he credited his success in life, not to his father, whose assistant he had been, but to his grandfather, who had died before Ah Chin had reached manhood's estate. He had a large practice and enjoyed a professional income of probably twenty-five hundred a year, which is the equivalent of twenty-five thousand dollars in our western civilization. He was popular and had a deserved reputation for generosity and kindness to the poor. His dress was simple, but very neat. He was entitled to wear a plastron on his coat, as well as a button in his cap, but he contented himself with the latter ornament alone. It took some time to break the ice with him, but after a while his confidence was won and in his leisure hours he would talk freely with a few of us western barbarians upon his profession.

There were some topics upon which he preserved a smiling silence. These were professional secrets which had come down in his family and which he would transmit inviolate as valuable property to his oldest son, who had already entered upon a successful medical career. The limitations of his mental horizon were very curious to one of our race. In some respects he had wonderful knowledge, while in others he was so ignorant as to arouse ridicule or pity. He was a master of acupuncture and could thrust a needle into almost every part of the human frame without doing any damage. He knew what the Chinese call the safe points, the dangerous points, and the dead points. He had learned these by practising for years upon a manikin which was covered with opaque wax, concealing the apertures which every good Chinese surgeon must know. And yet he had very little idea of why one point was safe and another perilous.

He knew there were veins and arteries in the body, but he knew nothing of their location and relation. He knew no more about the osseous system than an average American boy, but he did know considerable about the joints and how to treat dislocations. Of hygiene and sanitation he knew nothing and did not care about them. Outside of his own house, abutting upon the wall and flowing over into his yard, was a pile of filth and garbage whose stench could be perceived a hundred yards away. He was interested in western medicine, despising its theory and practice of medication and puzzling over rather than admiring its surgery. He approved of the germ theory but denied that the microbes were microscopic creatures, holding very vehemently that they were creatures intermediate between worms and snakes, and that they were the causes of every kind of fever. He believed that these snakes, or worms, laid many eggs which passed from the patient's body through the bowels, the pores, and even the lungs, settled in other bodies, and there hatched and attacked the new surroundings. He was quite successful in respect to several complaints, notably rheumatism, neuralgia, gout, eczema, ulcers, carbuncles, and diarrhœal complaints.

His methods for rheumatism, neuralgia, and gout consisted in the liberal use of hot teas and broths and a relinquishment of all ordinary food. In most of the fluids there was the simple tonic, ginseng; in others there were aperients, which apparently were impure Epsom salts; one broth contained peppermint leaves, chopped almonds, bay leaves, honey, blood and wine. So far as I could make out, he drenched the entire gastric system with immense quantities of hot water, washing out the entire body in that way, and relied upon the elements added to the water for medicinal action as well as for nourishment. In treating eczema he distinguished between an inflamed skin from which blood came at points and one from which merely lymph came. To the former he applied a paste made of pitch, peppermint, and some oils, and to the latter a paste made of raw eggs, honey, calcined kaolin, peppermint oil, laudanum and other substances. After the preparations were applied, the surface was covered with thin brown tissue paper, this in turn with thick brown paper, and this held in place by narrow strips of white cotton cloth. The heat of the inflammation dried the clay paste, which became quite hard in twenty-four or thirty-six hours. He broke it off by striking it with a little hammer, and then applied a new coating to the raw surface. An ordinary eczema he cured in a week, and a severe one in two weeks.

For stomach ache, gastric chills, flatulency, indigestion, and most forms of dyspepsia, he had a treatment which was truly heroic. The patient lay at full length, and the doctor with his muscular hands pinched the skin of the abdomen from the end of the sternum to the pubic bone, and transversely almost up to the backbone. The pinching was done with the thumb and forefinger or between the knuckles of the forefinger and middle finger. It was so powerful that sometimes it would draw or force blood through the pores and so rapid that it might be compared to playing a piano. In ten minutes, using both hands, he would inflict from three to four hundred pinches. It was more than a rubefacient and counter-irritant. It drew the blood to the surface, so much so that on the second day the body was covered with black and blue crosses and every nerve was excited to a condition of intense activity. I must say that the method, though cruel, had excellent results. There was immediate relief and a very speedy cure. He scarified, as do all Chinese physicians, but did it in moderation. He used aperients in large quantities and preached the unhealthfulness of constipation.

For catarrhal troubles he used warm solutions of astringents rendered aseptic by peppermint and similar oils, and where there was pain, as in nasal catarrh, he often applied an oil into which he had put tincture of opium. For some forms of dyspepsia he used burned paper. The paper was a thick yellow tissue which, when burned, left a fluffy black ash that was probably one-half carbon and the rest silica and mineral salts. Occasionally, perhaps always, he wrote talismanic characters with colored pencils on the paper. At first I thought the talisman was merely a melodramatic flourish, but after a while I noticed that he employed different pencils, and that each pencil was made of a substance which, when burned, would exercise a chemical or medicinal influence. The vermilion pencil consisted of red mercury; the brown pencil was red oxide of iron; the white pencil contained carbonates of calcium and magnesium; another pencil contained some salt of sodium, an impure carbonate if I remember aright. The pencils had blunt points, and in writing a talisman ten or twelve grains of material would be transferred to the paper. When it was burned and diffused in a cup of tea, the ingredient would pass into the stomach along with the carbon of the paper.

For sores and ulcers he had salves of various sorts, the active ingredients being peppermint oil, pitch oil, camphor oil, and opium. They were practically a simple antiseptic and disinfectant dressing, always giving relief and generally assisting Nature in effecting a prompt recovery. Take him for all in all, Ah Chin seemed to me very much like the poor leech in Romeo and Juliet. He had about the same range of simples, the same blind trust in his science, and the same ignorance of the higher science which modern therapeutics has brought into being.—New York Medical Journal.

A CASE OF TOTAL GASTRECTOMY.

By Dr. VIEIRA DE CARVALHO, in The Lancet.

THE patient was a woman, aged forty-six years, a native of São Paulo, Brazil, and was examined by me for the first time on March 25, 1900. She was a weak, almost cachectic mulatto, who said that she had suffered from stomach trouble for years, these troubles becoming much worse during the last six months. Lately it had become impossible for her to get nourishment, since on swallowing anything she was seized with acute gastric pains, followed, after some hours, by vomiting of the food taken, mixed not infrequently with dark blood. Her condition becoming daily worse, she resolved to enter the hospital.

She was extremely emaciated, weighing only 31 kilogrammes (68 pounds), but showed outwardly nothing else worthy of note. Palpation revealed the presence of a tumor of about the size of a turkey's egg in the epigastric region on the right side, close to the costal margin. This tumor was movable, painless even under pressure, and did not seem to give the patient much trouble. Examination of the patient, the history of the case, and the gastric symptomatology convinced me that it was a case of malignant tumor of the pylorus, and I resolved to operate as soon as possible, my intention being to perform gastro-enterostomy. I, therefore, had the patient prepared for the purpose of operating on her the next day. The preparation consisted of general antiseptic bathing, covering the entire abdominal surface with moist salicylated cotton, ordering a free purge, and total abstention from food for twelve hours prior to the operation, keeping up the strength with alcoholic stimulants. I know that it is the practice of some eminent surgeons to wash out the stomach with antiseptics before operations on this organ. I am not in favor of this procedure, as it causes fatigue and prostration; a patient already weakened by frequent vomiting should not be harassed by the introduction of the Faucher tube. Moreover, I was sure that the stomach would contain no food at the time of the operation, as any that might have been taken would be rejected by the repeated vomiting. I also consider the antiseptic value of washing out a cancerous stomach to be purely theoretical.

Before the operation the patient had a weak, slow, but regular pulse, sixty to the minute; the respirations were twenty. Everything being in readiness, she was chloroformed by my colleague, Dr. Mattoso. I then made a median incision embracing the region between the xiphoid cartilage and the umbilicus. The abdominal cavity being opened, I endeavored to confirm the diagnosis and ascertain the exact site of the lesion. I saw that there was a malignant tumor of the pylorus, with slight adhesions to the neighboring organs affecting the greater part of the lymphatics of the stomach. In view of this state of things, I gave up the idea of a simple gastro-enterostomy and began to think of a total gastrectomy, in imitation of Prof. Carl Schlatter.* Having resolved upon this procedure, I began to isolate the tumor, cutting away the omentum between ligatures, carefully uncovering the part of the duodenum not involved, breaking up an adhesion between the tumor, the duodenum and the head of the pancreas. The adhesions were broken up at the cost of a slight laceration of the pancreatic gland, causing a hemorrhage which was controlled by ligating en masse with catgut. The tumor and the duodenum being freed, I secured this part of the intestine with a Kocher clamp five centimeters below the limit of the neoplasm: a second clamp compressed the pylorus close to the tumor. As I separated the tumor from its adhesions and drew it out, I isolated with antiseptic gauze the peritoneal cavity from contact with the diseased organ to be removed, to avoid any accidental contamination. Between the two clamps I divided the duodenum through the sound tissues, and with corrosive sublimate gauze I disinfected carefully the cut surfaces and the exposed mucous membrane of the intestine. This done, I gradually isolated the stomach from below upward and from right to left, cutting the peritoneal folds between the clamps, extirpating at the same time the lymphatic ganglia involved, which were numerous. Having freed the stomach from its ligaments, I made strong traction downward, bringing the cardiac end as low as possible, and close to the diaphragm I applied to it a Kocher clamp; a little below I placed a second clamp, and between the two clamps I cut through the cardiac portion of the stomach. This part of the operation was very difficult, as the right lobe of the liver, very large in this patient, embarrassed my movements. In consequence of having been obliged to apply the clamp just as I did, the section of the stomach was slightly oblique; later, when the sutures were applied, the diameters of the pylorus and the cardiac end of the stomach did not correspond. After careful disinfection of the cut surfaces and of the exposed mucous membranes, I commenced the suturing. It was difficult to bring together the two extremities that were to be united. I made the suture with flue silk, in a double row, as advised by Hartmann* and Terrier—a process too well known to need describing here. The suturing being completed, the parts united and the whole neighborhood were again disinfected with a solution of sublimate of moderate strength (1 in 1,000). The isolating pieces of gauze were now removed, as were also the clamps. On account of the powerful retraction of the œsophagus, the recently joined parts were drawn immediately into the abdominal cavity. I then cleansed the peritoneum and closed the abdomen with triple sutures, one above the other. The operation lasted one hour and twenty minutes, leaving the patient in a state of profound shock, with the pulse almost imperceptible, the respiration superficial, and the skin covered with cold, clammy sweat. The means employed to restore her were successive injections of ether, caffeine and strychnine, hot applications, and placing her in a position with the head lowered. As soon as the circulation began to improve I made an injection of one and one-half liters of artificial serum. The effect of the serum was rapid, and in a few hours the condition of the patient was encouraging. I ordered nutritive enemata every six hours. In the evening the condition of the patient was good. She was perfectly conscious; the respirations were normal, the extremities were warm, the skin was moist, the pulse was strong but very rapid (140 to the minute), and the temperature was 36·7° C. Small doses of alcohol (Todd's mixture) were ordered.

On March 28 the patient's general condition was good. Her pulse was strong, 140 per minute; the respirations were 20 per minute; and the temperature was 37·4° C. Four hundred grammes of normal urine were passed. Three nutritive enemata per day were prescribed, with small doses of milk. As the patient complained of intense thirst, I ordered Vichy water ad libitum in small doses. On the 29th her general condition continued good. Her tongue was clean, her temperature was 37° C., her pulse was 120, and her respirations were 20 per minute. Nine hundred grammes normal urine were passed. Nutritive enemata were continued, with small doses of milk and broth. The patient complained of hunger. Her tongue was clean. On the 30th her general condition was good, her tongue was clean, her temperature was 37° C., and her pulse was 120. Eight hundred grammes of urine were passed. Nutritive enemata, milk, broths with somatose, Vichy water and alcohol were continued. On the 31st there was nothing new to be noted. Her temperature was 37° C. and her pulse was 120. Nine hundred grammes of urine were passed. The patient continued to complain of hunger. On April 1 her general condition was good. Her tongue was clean, her pulse was 110, and her temperature was 37° C. Nine hundred grammes of urine were passed. She had two copious movements of the bowels, the fæces being firm and yellowish, with a few coagula of milk, indicating good digestion. On the 2d her general condition was good. The pulse was 120. Nine hundred grammes of urine were passed, and there was a small movement of the bowels. Her diet was continued as before. On the 3d her general condition was excellent, and there was nothing new to record. The dressings were now removed, and it was found that primary union had taken place. The superficial sutures were then removed. Food was ordered to be given in small quantities every two hours. On the 4th all was still going on well. The patient had a ravenous appetite, and begged for more solid food. She wished at any risk to eat a mixture of beans and flour. Examination of the removed stomach showed that the operation was reasonable, for, besides a tumor ulcerated at the pyloric end and extending upward over the great curvature of the stomach, there were numerous ganglia involved in sundry parts of the organ.

In giving this account of what I judge to be the first total gastrectomy done in Brazil, I have no other than a strictly scientific end in view. I am of those who think there is no merit in being the first to repeat an operation, however rare. Surgical processes and difficulties do not vary with the latitude. At all events, I think it right and proper to record this new case in the interest of the bibliography of the subject. It raises to four the number of successful total gastrectomies, three being recorded in the masterly work of Hartmann and Terrier on the subject published at the end of 1899. Later, should my patient survive, I intend to present a detailed work on the case, for the absence of

* For Prof. Schlatter's full account of this case see The Lancet, January 15 (p. 141), and November 19, 1898 (p. 1314).

* See Dr. Hartmann's letter in The Lancet of September 15, 1900, on page 840.

the stomach opens a wide field for the study of digestion. Who knows how much we may have to reform our knowledge of the subject, from the sensation of hunger to the digestion of meat; from the need of gastric hydrochloric acid to the function of the pancreatic juice?

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

New Zealand Vegetable Novelties.—In Yates' "Annual" for 1900, I have noticed descriptions of several novelties in vegetables, which should prove a boon to localities where droughts are not unfrequent, and especially to cabbage growers. A certain cabbage, called "Yates' aphis-proof cabbage," an Australian-raised variety, gave, notwithstanding the intense drought of last summer, good hearts and remained almost entirely free from aphis, while every other variety of cabbage was riddled by the pest. A better opportunity could not have occurred for testing its hardiness. After the heart is cut, it throws out a number of small hearts and loose leaves, all of which are tender and of a good flavor; and, as they rapidly reproduce themselves after cutting, a bed of these cabbages will keep a house in vegetables all through the summer and autumn. A cabbage that would really resist aphis and stand the hot, dry summers has long been a desideratum in Australian gardens, and it is thought that this variety will meet the want.

Another vegetable worthy of attention is an "African cucumber," a plant of the cucumber family from Rhodesia, South Africa. The fruit is six inches long, of a bright orange color, and covered with spines. Even for ornamental purposes the plant is well worth growing; but it may be also used as a fruit, the flesh being soft and juicy, and in appearance much like passion fruit. Eaten with sugar, the flavor is very similar to that of a rock melon.

Another novelty is called the "mongri," or edible podded radish. It is a new vegetable from Java, and is as easily grown as the ordinary radish, producing enormous crops of long pods, which are crisp and tender, with a delicious flavor. Persons who cannot eat the common radish because of its indigestible qualities should hail this new variety with pleasure. It makes an excellent salad; it is also delicious when boiled, having a delicate asparagus flavor.—Frank Dillingham, consul at Auckland, August 14, 1900.

Licenses for Foreign Commercial Travelers in Russia.—Vice and Acting Consul-General Hanauer writes from Frankfort, September 11, 1900:

The Bureau of the German-Russian Association, in Berlin, announces that according to a late decision of the Russian Imperial Council, members or employés of foreign firms, when traveling in Russia for the purpose of purchasing goods, do not come under the trade-license act and need not pay any tax.

Hydraulic Presses in Madagascar.—Consul Gibbs writes from Tamatave, September 3, 1900:

Mr. Christian Bang, a reliable merchant of this city, requests names of manufacturers of small hydraulic presses for baling raffia and other fibers. I think there is a field here for these presses, if they are of the proper size. Correspondence with Mr. Bang may be conducted in the English language.

Musical Instruments in Germany.—Vice and Acting Consul-General Hanauer, at Frankfort, September 6, 1900, says:

In musical instruments, such as accordions, violins, guitars, zithers, trumpets, clarinets, etc. (not including pianos and organs or orchestrions), the exports from Germany to foreign countries during the first six months of this year amounted to 6,838,000 marks (about $1,750,000) in value, and exceeded those shipped abroad in the same period of 1899 by 12·7 per cent. Of these, England took 16 per cent.; Austria-Hungary, 5·9 per cent.; Russia, 5·7 per cent.; France, 5·2 per cent.; Australia, 3·3 per cent.; Argentina, 2·2 per cent.; Brazil, 1·9 per cent., etc.

Under date of September 4, Mr. Hanauer reports:

A German technical paper says that an attempt is being made to inundate the German market with American pianos, as has been done with melodeons, organs, and bicycles. A prominent maker of pianos who was at the Chicago exhibition predicted this result six years ago. The paper adds that the new German customs tariff should guard against this danger.

Consumption of Corn in Germany.—Under date of September 11, 1900, Vice and Acting Consul-General Hanauer, of Frankfort, writes as follows:

Indian corn does not mature when planted in Germany and other countries of central and northern Europe. Since 1891, when Europe imported but 23,000,000 bushels of this grain from the United States, its use as cattle feed has steadily grown, and last year's imports from the United States alone aggregated 189,000,000 bushels. Of this, 45,250,000 bushels went to Germany, which country also imports small quantities from Turkey and Roumania. If our exporters were to make energetic efforts to educate the European people to the various uses of Indian corn as a palatable and wholesome article for human food, our exports in corn meal and corn would attain astonishing proportions and become of great benefit to the poor working classes of Europe. A commencement might be made by introducing corn cakes, mush, hominy, corn bread, etc., in the "people's kitchens" of the large cities in Europe, where a cup of coffee can be had for a small sum—here in Frankfort for 5 pfennigs (1¼ cents).

Germany's Imports of Butter.—Under date of September 24, 1900, Vice Consul-General Hanauer, of Frankfort, says:

The consumption of imported butter is increasing in Germany, having amounted to 8,098·7 metric tons (of 2,204 pounds) during the first seven months of this year, against 5,784·1 tons for the same period of 1899. Of the above amount, Holland furnished 2,850·8 tons; Austria-Hungary, 2,476·3 tons; and Russia, 1,685·9 tons. Our butter is equal to the best produced, and I see no reason why the United States should not supply the market here with this commodity, as it does with lard, meat, and grain. The German agrarians and their sympathizers consider the present German tariff rate on imported butter—16 marks, or $3.80, per 100 kilogrammes, or 220·46 pounds—too low to protect the domestic producers.

Lumber Trade in Germany.—Consul Winter, of Annaberg, September 12, 1900, states that according to statistics of transportation on the German railways, lumber takes the fourth place in point of weight. The total traffic of all the railroads in the empire for 1897 amounted to 217,523,247 tons. Of this total, 12,587,330 tons were lumber. This is of special interest, he adds, when we take into consideration that it does not include lumber transported on the different rivers of the empire. The importance of this industry in Germany is shown by the fact that the various lumber establishments give employment to about 600,000 persons. The well-arranged system of forestry in the empire supplies home markets with soft woods, but the imports of hard woods from abroad are steadily on the increase.

New Commercial Treaties of Italy.—Vice and Acting Consul-General Hanauer writes from Frankfort, September 22, 1900, as follows:

Following the examples set by Germany and, of late, by Russia, Italy has organized a permanent board or commission of experts for the purpose of preparing for new trade treaties with foreign powers. Its first task is the examination of reports of Italian chambers of commerce. It will then consider the lately enacted increase in the Russian tariff, and prepare a reciprocity treaty with Germany.

Hats in Paraguay.—Under date of August 12, 1900, Vice-Consul Harrison, of Asuncion, writes as follows:

Hats for men are imported into Paraguay from England, France, Buenos Ayres, and Montevideo. The selling prices are exorbitant, twice as high as in the United States for the same class of goods. A derby which costs about $2 in the United States sells here for $4, and sometimes $5. Soft hats are very much in demand and sell at even a greater profit. The hats which have the largest sale are of good, but not of the best, quality.

Locomotives and Trucks in Cape Colony.—Consul-General Stowe sends from Cape Town, August 31, 1900, copy of a circular issued by a Rand firm to mining companies, saying that, in view of the scarcity of rolling stock, the director of railways proposes the purchase in England or elsewhere of fifteen 69-ton engines of similar pattern to those recently ordered by the Natal government railways, the cost to be about £4,000 ($19,466) each; also of two hundred 30-ton flat-bottomed steel trucks with bottom openings, of a type suitable for the conveyance of general goods, to cost about £400 to £500 ($1,946 to $2,433) each.

Mr. Sowe adds:

The Chamber of Mines has been discussing the question to the end that orders may at once be placed. Tenders have been asked for from United States manufacturers, and the bids are much lower than those from England. The time of delivery is also in favor of the former — thirteen weeks against six months. I am informed that an order for about one thousand ordinary flat cars has been placed by the colonial railways of Cape Colony. The military director, I am told, favors English manufacturers, even at higher figures.

Electrical Goods in Turkey.—The chargé at Constantinople, Mr. Griscom, writes under date of September 1, 1900, that about two months ago a United States firm made a shipment of electrical appliances to Constantinople. Upon arrival there, the merchandise was seized in the custom house, and refused admittance to the empire, the introduction of electrical appliances of any description being prohibited. Mr. Griscom caused some samples of the goods—small reading lamps, toys with storage batteries attached, etc.—to be taken to the palace, and brought to the attention of the Sultan. The latter was much attracted by the novelty of the articles, and bought the whole consignment for his personal use. He also issued an irade authorizing the introduction of similar articles into the country.

It is to be hoped, adds Mr. Griscom, that a permanent trade may be established in this class of goods, though it should be understood that the irade does not refer to electrical appliances of all kinds. The general interdiction against dynamos, electrical plants, telephones, etc., still exists.

Sulphate of Copper in Greece.—Vice-Consul Maximos, of Patras, under date of September 12, 1900, writes as follows:

Sulphate of copper will be largely used this year as a remedy against the disease peronosporos, which has lately caused so much damage to the currant and grape vineyards. The importation will exceed 5,000 tons. This article is imported from Great Britain and Belgium. In my opinion, a great part of the sulphate of copper could be imported from the United States, and many importers here have asked me for names of reputable American firms connected with this trade. I am most willing to furnish to our exporters any further information.

Peat as Fuel in Russia.—Consul Hughes writes from Coburg, August 22, 1900:

The question of the scarcity of fuel in Russia has long occupied the attention of scientists. Coal is found only in small quantities, while wood is by no means sufficiently abundant to warrant extensive consumption. It is proposed to surmount the difficulty by turning the enormous quantities of peat to account. In many districts, the turf almost represents the staple fuel. Its calorific power is said to be double that of wood. The turf is compressed into small briquettes and sent to the market. It is estimated that the cost of manufacturing it for commercial purpose is about $5.84 per ton, which at present compares very favorably with the price of coal.

American Flour in South Africa.—Consul Hughes, of Coburg, September 6, 1900, quotes the following article from The Melbourne Journal of Commerce:

It is the height of folly to send flour to South Africa in 200 pound bags, that being a country where the natives are not disposed to handle heavy packages. Especially is this true at present, when handy packages are so much in request for transport by mules, pack horses, etc. The 50 or 100 pound bags of flour from the United States arrive out white, clean, and tastefully branded, with no chance of rough jute fibers finding their way into the material. The Australian bag, on the other hand, is unwieldy, out of all decent shape, and looks dirty and uninviting. We are assured that repeated consignments of American flour pass through the Durban stores while one Australian importation is being got rid of. There are a few millers and shippers on this side—notably one at Newcastle, N. S. W.—who seem to understand the business, but the greater number appear altogether indifferent.

Swiss Steel Industry.—Under date of August 22, 1900, Consul Hughes, of Coburg, says:

Switzerland has not until now been noted as a center for steel production, though her engineers have long held a high position in the mechanical world. Recently, however, a company has been formed to work the great deposits in the Bernese Oberland, where there are many million tons of ore available, averaging 50 per cent. of iron. It is intended to smelt the metal electrically, the large water power, cheaply obtainable, giving the project a reasonable prospect of success.

Demand for Railway Material in Syria.—Consul-General Dickinson, of Constantinople, writes from Binghamton, N. Y., October 15, 1900:

The delay in obtaining the British concession for the proposed railway line from the Syrian coast at Haifa to the city of Damascus seems now to be at an end. It was supposed that a valid concession had been granted, and surveying and other preliminary work was going on, when it was claimed that one of the official signatures to a document relating to the concession was in dispute. The British embassy at Constantinople has been at work upon the matter, and it is now believed that the question is satisfactorily settled.

The proposed line is to be of single track, and is to be about 120 miles long. The most profitable business in sight will be the carrying of wheat from the fertile Hauran district to the coast. The road will also be a competitor for the through traffic which now goes over the narrow-gage road from Damascus to Beirut, and it will have a distinct advantage over the latter on account of its easier grades.

Contracts for the supply of material have not yet been let, and proposals from American manufacturers are desired. Communications should be addressed to A. J. Hill, Thames Iron Works, London.

Transportation and Trade in Guatemala.—The recent successful negotiations for the completion of the Northern Railway, entered into between the Guatemala government and the Central American Improvement Company, have had a stimulating effect on the people of the republic. The completion of the railway will effect direct communication between the Atlantic and Pacific, and will no doubt attract shippers in the direction of New Orleans and the Gulf. Heretofore, the principal American imports have come by the Pacific Mail Steamship Company's boats from San Francisco, there being a direct steamer route from that city to the port of San José de Guatemala (which port is the terminus of the Central Railway), operated in conjunction with the Pacific Mail, both being controlled by the Huntington syndicate. Transportation on the Atlantic side via the Gulf of Mexico has been an impossibility, owing to the lack of railway facilities from El Rancho to the city of Guatemala, a distance of 60 miles.

Pacific coast transportation has been improved by a new German steamship company, "Kosmos," making closer connections with the United States via San Diego, Cal. This has caused a slight reduction in freight rates. Harbor dues remain the same, while lighter and wharf charges are 20 per cent. higher.

Permit me again to emphasize the necessity of our manufacturers showing their goods. The catalogue and circular method of advertising does not appeal to the buyers in Guatemala. A display is necessary. By this method, the European houses have captured and retain the trade. I repeat also, that the American manufacturer must make what the people want. They must study the trade and gratify the people in this regard. The establishment in Guatemala City of a sample warehouse, where United States manufactures and products can be seen and examined, would no doubt serve to increase our trade in this republic. If, therefore, American houses desire the trade of Guatemala, they must comply with the following conditions: Show their goods and demonstrate their merit; give longer credits; pack well and cater to the wants of the people, who by universal custom wear certain styles and qualities and will not change. American houses, by reason of geographical advantage as well as superior quality of goods, should have a monopoly of this market. This can readily be accomplished by complying with the conditions I have just mentioned.

I believe that a small, inexpensive cooking stove would find a ready sale in this market. Those I have seen are either too large or too expensive.—James C. McNally, Consul-General at Guatemala.

Stettin-Swinemunde Canal.—Consul Kehl, of Stettin, under date of September 21, 1900, reports that the water-way from Swinemünde to Stettin, a distance of about 35 miles, has been dredged, and is now open to steamers drawing 22 feet.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

STEAM ENGINES AT THE EXPOSITION OF 1900.

THE great gallery of steam engines at the Exposition offers a spectacle of very great interest. We find here the most diverse types of engines of all countries, the most important of which we shall pass successively in review in starting at the extremity of the hall bordering Avenue de la Bourdonnais.

MM. Crepelle and Garand, of Lille, have set up a compound steam engine of 1,200 horse power, which runs a Decauville dynamo. The Compagnie Fives-Lille runs a 1,200 horse power compound Corliss engine at 80 revolutions a minute. The Société Alsacienne de Constructions Mecaniques exhibits a vertical steam engine of 1,200 horse power of the type adopted for the electric works of the Quai Jemmapes at Paris.

The Société Française de Constructions Mecaniques (Anciens Etablissements de Cail) exhibits a 1,250 horse power vertical compound steam engine (Allis type) with the Reynolds-Corliss distribution, making 75 revolutions a minute. The high pressure cylinder is 0·813 meter in diameter, and the low pressure one 1·22 meter. This engine directly actuates a triphased current alternator of 1,000 kilowatts, exhibited by the Thomson-Houston Company. It consists of two independent bed plates, each of which carries, cast in a piece, one of the two principal pillow blocks of the main shaft. Upon these plates, and serving as a support to each of the cylinders, two pieces of cast iron with a parabolic profile, and of equal resistance, serve as a frame and slide for each of the engines. The main shaft, which is supported by two pillow blocks, carries a crank plate at each of its extremities. Between the pillow blocks the shaft supports the fly wheel, the weight of which is 70 tons, and the revolving inductor of the alternator, the weight of which is about 25 tons. The double-jacketed cylinders are provided with rotary cut-offs, placed in the bottom. The pillow blocks are provided with spherical bearings cooled by a circulation of water. The admission cut-offs of the two cylinders are provided with the Reynolds-Corliss system of cam. There are two governors on the engine, one of which acts directly upon the expansion of the two cylinders simultaneously, and the object of which is to distribute the power as completely as possible over the two cylinders for all the degrees of expansion, and the other, which is a mere safety apparatus, shuts off the entrance of steam when the angular velocity exceeds a certain limit. The condensation is effected through an independent vertical air pump and condenser.

A Laval turbine, which is installed in the vicinity, directly actuates dynamos in several places. This turbine has long been known and has rendered numerous services in the industries, in cases in which there was a hesitation about employing motors of so high an angular velocity. We may note that the consumption of steam does not exceed 10 or 12 kilogrammes per effective horse power.

Afterward come the horizontal steam engines of MM. Piguet and Company, of Lyons, and of MM. P. and A. Farcot. It is well to remark that the latter are among those rare manufacturers who exhibit at the same time a complete group of electric generators. They also show a steam engine and alternator constructed at the Saint Ouen Works. The motor is a single cylinder one. The diameter of the piston is 1 meter and the stroke 1·35. The angular velocity is 78·5 revolutions per minute. At a pressure of 7 kilogrammes to the square centimeter at condensation and at 0·1 of introduction there is obtained 900 indicated horse power, and at 0·2 and 0·3 of introduction the motor may reach 1,300 and 1,600 horse power. The governor carries a nut screwed upon a threaded rod. This arrangement permits of obtaining a continuous regulation of the angular velocity for the coupling in parallel of the alternators in service and for the regulation of the charge of the alternator.

MM. Dujardin and Company, manufacturers at Lille, exhibit several models of steam engines of their construction, one of which, of 1,500 horse power, is for actuating a Schneider 1,000 kilowatt alternator, and the other, of 800 horse power, for actuating a 600 kilowatt triphased current alternator of the L'Eclairage Electrique Company. The 1,500 horse power motor is a triple expansion condensation one, provided with four cylinders. It is horizontal, and has two cranks keyed at 90°. There is a high pressure, a mean pressure and two low pressure cylinders. The two latter are fixed to the frames; with that to the right is connected the high pressure cylinder in tandem, and to that to the left the mean pressure cylinder. The cylinders rest upon frames that serve as slides. In the high pressure admission cylinder the system of steam distribution is that of Dujardin with four cut-offs of the Corliss type placed at the lower part of the cylinder and having a cam controlled by the regulator of the admission. The same is the case with the mean pressure cylinder, in which the cam is regulated by hand for the admission, and also with the low pressure cylinders, in which there is no cam. Each cylinder is provided with a steam jacket. Each side of the motor is provided with a cylindrical condenser, and with two vertical single acting air pumps. The diameter of the high pressure cylinder is 0·61 meter, that of the mean pressure one 1·05, and that of the low pressure ones 1·05. The stroke of the pistons is 1·65 meter and the normal power is 1,500 horse power at 72 revolutions per minute. For 1,700 indicated horse power, the total expansion is 19 per cent., and the corresponding admission at the high pressure cylinder is 51. The steam is at a pressure of 11 kilogrammes to the square centimeter.

The Dujardin motor, which actuates a 600 kilowatt alternator of the Eclairage Electrique Society, is a compound condensation one with two cylinders in tandem, and is of the horizontal type, with one crank. The low pressure cylinder is fixed to the frame. The high pressure cylinder is arranged in tandem. The angular velocity is 80 revolutions a minute. We might mention various other Dujardin engines, but are obliged to confine ourselves to the principal models.

MM. Bietrix, Leflaive, Nicolet and Company, of Saint Etienne, have installed a compound tandem steam engine with valves of the Collmann type, and which actuates a Labour multipolar shunt generator of 200 kilowatts at 110 revolutions a minute.

MM. E. Garnier and Faure-Beaulieu, successors to MM. H. Lecouteux and Garnier, known since 1873 for their construction of Corliss engines, exhibit models of Corliss horizontal condensation engines with expansion variable through a governor. The principal advantages of these engines are a great simplification of the expansion mechanism, an almost complete suppression of useless spaces, a variation of the expansion by about 0·8 of the stroke of the piston, an automatic stoppage in case of non-operation of the governor, and a great saving in steam.

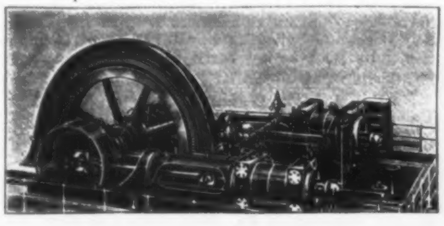
The Delaunay-Belleville establishment has for some years past been constructing double vertical engines with double, triple and quadruple expansion, with cylindrical valves, and with high angular velocity, for powers of from 10 to 2,000 horse. The power is varied through a ball governor placed at the extremity of the shaft opposite the fly wheel and controlled by pinions. This governor acts upon a trundle which varies the pressure of admission at the small cylinder. In this engine all the movable parts are lubricated by means of oscillating pump without clacks, which is actuated by the motor and forces the lubricant into a conduit that forms a continuous circuit and connects the various joints with each other. These engines are easily inspected and dismounted. From numerous experiments made by the manufacturers, it results that the consumption of steam per effective horse hour does not exceed 9 kilogrammes, and that the mechanical renderings are notably improved. At the Exposition may be seen a triple expansion four-cylinder engine of 1,250 horse power that actuates a Boucherot alternator at an angular velocity of 250 revolutions a minute.

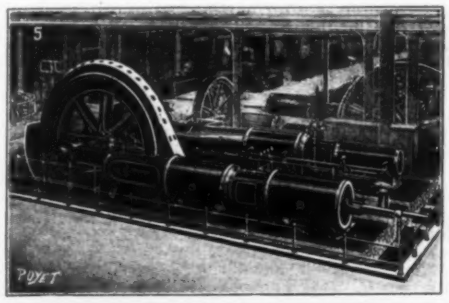
The Weyher and Richemond establishment has installed two horizontal steam motors of 1,000 horse power and one of 500 horse power with four distributors, and with instantaneous starting gear controlled directly by the governor through members having a lengthy travel. The variation of the introductions of from 0 to 0·75 of the stroke of the piston is effected automatically. The angular velocity is kept constant by a special compensator. These engines operate with vertical condensers having a double air pump. The same house exhibits multitubular boilers with curvilinear tubes. Weyher horizontal stationary expansion engines, horizontal stationary compound engines, with two cylinders, a triple, a vertical stationary engine, and several models of locomotive engines.

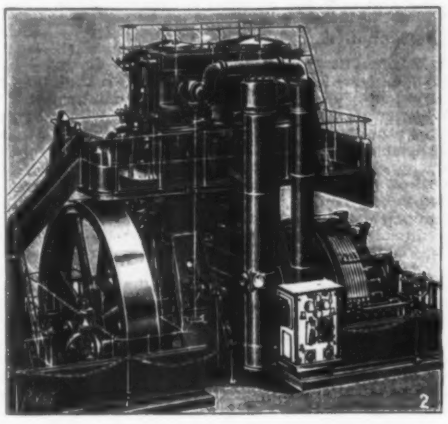
Reaching the Machinery Hall of Suffren Avenue, set apart for foreign engines, we find in succession a compound condensation steam engine of 550 horse power of Robey and Company, a 500 horse power steam engine of Galloway and Company, and a vertical triple expansion steam engine of 2,400 horse power of Messrs. Willians and Robinson. This latter, which weighs 120 tons, is remarkable by its extraordinary dimensions. The type is already known, and has been utilized in numerous industrial installations. The Ringhoffer establishment, of Smichow, near Prague, exhibits a horizontal steam engine of 1,600 horse power.

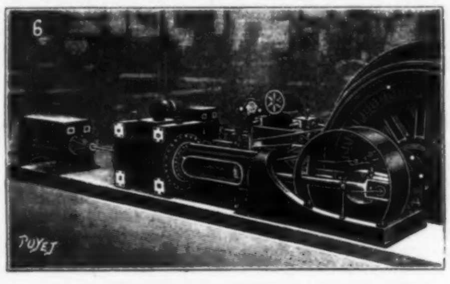
The combined manufactories of engines of Augsburg and Nuremberg show us several motors that are really remarkable. There is, in the first place, a horizontal triple expansion and condensation engine of 1,800 horse power at 72 revolutions a minute. This engine is formed of two groups of cylinders, between which is placed a Helios alternator that serves as a fly wheel. Each group of cylinders is formed, one of them of the high pressure cylinder and low pressure one placed in tandem, and the other of a mean pressure cylinder and of the second low pressure one placed in tandem. In this way, it has been possible to increase the velocity of the pistons, without increasing the length—the result being a saving in steam. To each of the low pressure cylinders are adapted an air pump and a condenser. The distribution of steam in the cylinders of this engine is obtained by means of double seated admission and eduction valves actuated by levers and pawls moved by secondary shafts. This distribution by balanced double seated valves is interesting. Let us add that arrangements have been provided to permit of variations in the admission.

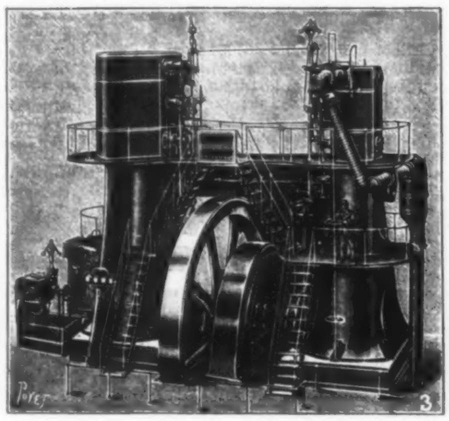
The second steam engine exhibited by the above-

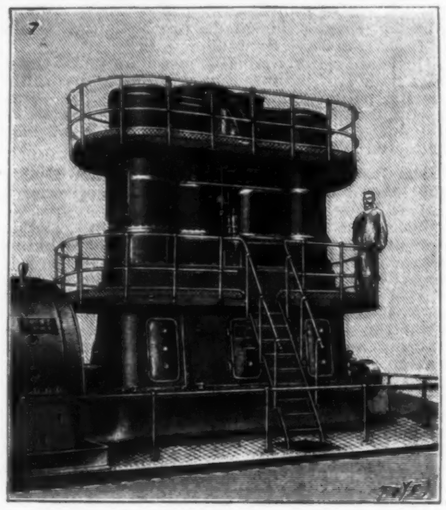


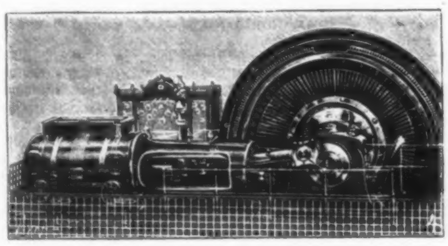


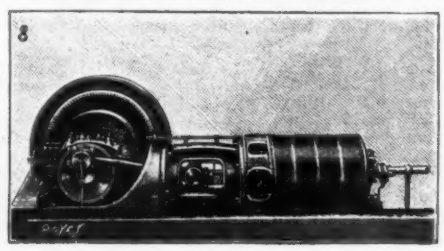












1. Farcot Single Cylinder Steam Engine. 2. Compound Vertical Engine of the Société des Anciens Etablissements Cail. 3. Engine of the Société Alsacienne de Constructions Mecaniques. 4. Corliss Compound Steam Engine. 5. Dujardin Triple Expansion Steam Engine. 6. Garnier and Faure-Beaulieu Engine. 7. Delaunay-Belleville Engine. 8. Weyher and Richemond Horizontal Engine.

STEAM ENGINES AT THE EXPOSITION OF 1900.

…med companies is a vertical triple expansion one of 2,000 horse power, coupled directly with a continuous current dynamo and a triphased current alternator of the Elektricitäts-Aktien-Gesellschaft. This is an upright triple expansion and condensation engine, with three cranks, and an angular velocity of 83 revolutions per minute. The diameters of the cylinders are respectively 0·775, 1·24 and 1·8 meter, with a common piston stroke of 1·1 meter. The total weight of the engine is 240 tons.

Let us mention, in addition, a vertical compound steam engine of 1,500 horse power at 94 revolutions per minute and at a pressure of 10 kilogrammes per square centimeter. It is a question of a compound vertical engine with two cranks. The diameters of the steam cylinders are 0·865 and 1·33 meter, and the common stroke of the pistons is 1·1 meter. This engine directly actuates a triphased current alternator and a continuous current dynamo of the Elektricitäts-Aktien-Gesellschaft.

The Siemens and Halske establishment of Berlin has installed a remarkable group of generators of electricity, with a Börsig vertical 2,500 horse power steam engine of 85 revolutions a minute. This engine, which is of a height of 12·5 meters and a weight of 350 tons, is a triple expansion one with four cylinders, two of which are for low pressure. Each low pressure cylinder is placed beneath the other ones of high or mean pressure, and mounted in tandem therewith. The pistons of the two cylinders in tandem are fixed upon the same rod. The diameters of the cylinders are 0·76 meter in the high pressure one, 1·18 in the mean pressure, and 1·34 in the low pressure. The stroke of the pistons is 1·2 meter. The motor shaft is in two parts, connected by flanged sleeves, and rests in four pillow blocks cast in a piece with the bed plate. Without dwelling upon all the details, we may add that the distribution in all the cylinders is effected through two-seated balanced valves arranged in pairs in a special box. The valves are lifted by levers and cams and reseated by springs. The oil is distributed in abundance by the Collmann system, the object of which is to retard the fall of the valve as well as to diminish shock and noise. The two air pumps of the condenser are established in the basement, and are single acting.

The water of injection is taken from the piping of the Chateau d'Eau. Beneath each of the cranks, upon the floor, there are reservoirs that receive the lubricating oil. Two centrifugal pumps suck up this oil and send it to a purifier, and thence to a series of distributors, which lead it to the different parts to be lubricated.

Next we meet with a compound horizontal, four-valve Bollinckx steam engine of 1,100 horse power. This engine is characterized by the efficiency of the jacket and by an abundant lubrication in the different parts.

A 1,000 horse power steam engine from the Van den Kerchove works actuates an alternator of the Compagnie Internationale d'Electricité of Liege. This compound tandem engine operates at a pressure of nine atmospheres and at a total expansion of about thirteen times the volume introduced. The small cylinder has a diameter of 0·63 meter, and the large one of 1·09. The stroke of the pistons is 1·2 meter. This motor is provided with a new system of distribution which consists in the use of four cut-offs having the form of pistons and working vertically in the bottom of the cylinders. These valve-pistons consist of rings provided with segments. They are connected through feathers with the rods that control their motion. The boxes in which these valves work are provided with apertures that establish a communication with the cylinder. When the cut-off placed above rises, it uncovers the apertures, and the steam at the bottom of the cylinder can then enter the latter. The descent of the piston assures the closing of the admission. These different arrangements have permitted of reducing to a minimum the quantity of air carried along by the steam, as well as the useless spaces.

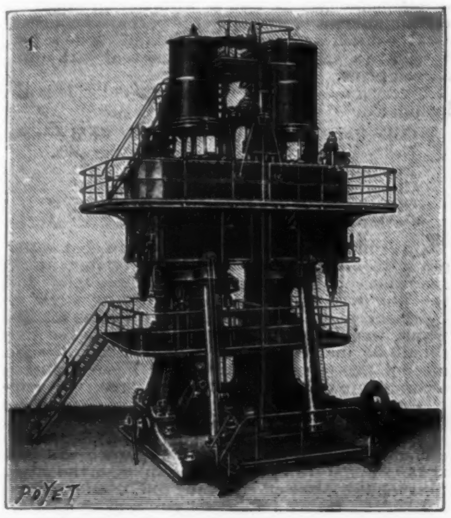
The Carels Brothers, of Gand, Belgium, exhibit a compound tandem steam engine of 1,000 horse power, which actuates a Kolben alternator at an angular velocity of 94 revolutions a minute. The two cylinders are mounted in tandem. The diameter of the high pressure cylinder is 0·66 meter, that of the low pressure one is 1·05, and the stroke of the pistons is 1·15. In each cylinder the steam is distributed by four balanced valves of the Sulzer type. In the high pressure cylinder the expansion is varied from 0 to 75 per cent. of the stroke of the piston by means of a special governor. The distributing mechanism is controlled by a longitudinal transmission shaft.

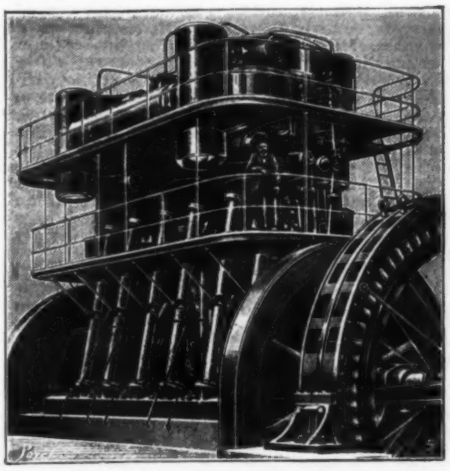
In the Swiss section we find an interesting group of steam engines and dynamos of 1,000 horse power, exhibited in common by the Société Anonyme des Ateliers de Constructions Mecaniques Escher, Wyss and Company, of Zurich, and the Oerlikon establishment. The engine is a compound horizontal one with cylinders in tandem. The cylinders have diameters of 0·65 and 1·1 meter, and the stroke of the pistons is 1·2 meter. At a pressure of admission of 9 to 10 atmospheres the engine gives its normal 1,000 horse power at 105 revolutions per minute, in actuating an Oerlikon alternator of 1,500 kilowatts. The distribution of steam takes place in every cylinder through four Corliss cylindrical slide valves. Each distribution is actuated by an independent eccentric.

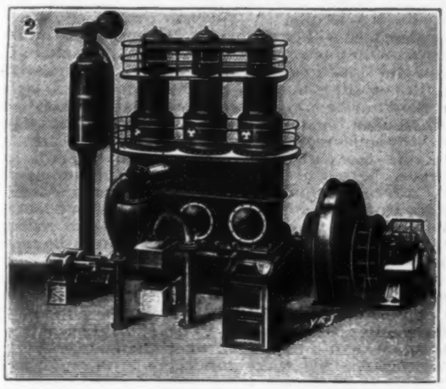
Escher, Wyss and Company also exhibit a vertical steam engine with triple expansion, with distribution by slide valves, and of 300 horse power at 175 revolutions per minute, as well as a series of the Francis double turbines of 2,500, 1,500, 1,000, 600, 220 and 110 horse power.

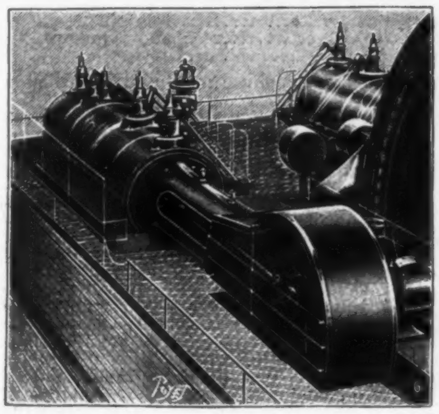
The Sulzer Brothers, of Winterthur, have installed a compound horizontal tandem steam engine at 700 horse power for actuating, at 100 revolutions per minute, a Brown-Boveri triphased current alternator. A second engine is a triple expansion one of 1,700 horse power at 85 revolutions per minute. The Sulzer engines are characterized by distributing valves arranged in each of the steam cylinders, and by the external disengagement mechanism of the valves. The last are balanced and present a wide section to the passage of the steam. They are actuated by the Sulzer system of cam distribution. The valves are particularly adapted for powerful engines of high angular velocity and of high pressure.

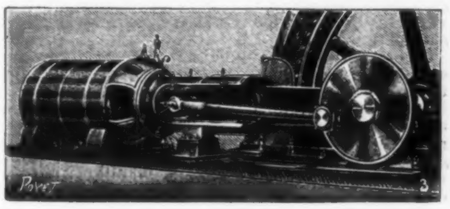
Such are, briefly summed up, the striking peculiarities of the steam engines installed at the Exposition of 1900.—La Nature.

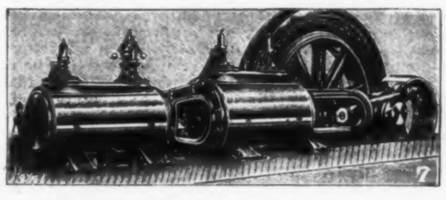


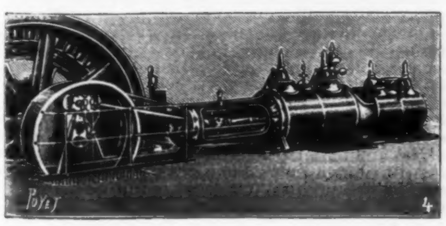


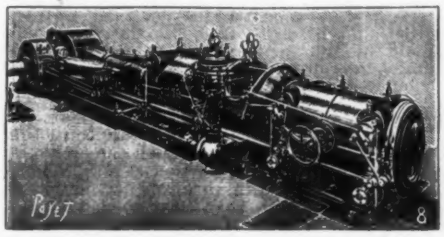












1. Börsig Vertical Steam Engine. 2. Willians & Robinson Vertical Engine. 3. Bollinckx Compound Horizontal Engine. 4. Sulzer Compound Steam Engine. 5. Augsburg Vertical Steam Engine. 6. Augsburg Horizontal Engine. 7. Carels Compound Engine. 8. Horizontal Steam Engine of the Société Escher, Wyss & Co.

STEAM ENGINES AT THE EXPOSITION OF 1900.

THE WINE INDUSTRY IN CHILE.

THE vine has been cultivated in Chile for a long time; it was introduced by the Spaniards immediately after their arrival in that country, but Chilean viticulture had not assumed any real importance until thirty years ago, coincident with the introduction of the French plants and modern means of cultivation. From its climate, its soil, and its topographical configuration Chile presents the most favorable and natural conditions for the vine-growing industry, and it is destined to be a great producer of excellent wines of all classes. The vine-growing district extends from the extreme north to latitude 39° south. It is to be found located principally in the valleys, plains and hills of the maritime zone of the south central region. H. M. Consul-General at Valparaiso says in his last report that there are in Chile two very diverse regions for vine growing—viz., the irrigated vineyards and the vines on dry or unirrigated lands. The former are found on the plains and valleys of the north and central regions; the second occupy the slopes, hillocks, and low hills of the zone on the coast of the central southern region. Also in the last named region vineyards are to be found unirrigated in the plains and valleys. In each region one can distinguish the old or original vineyards composed of the Spanish vines and the modern French vineyards composed of the vines from Burgundy and Bordeaux.

The watered or so-called French vineyards are cultivated on lines of palisades over wires sustained by posts of wood which is usually the Chilean cypress. The rows of vines are divided one from the other by from 5 feet to 6½ feet, and the distance between the roots on the line is from 3¼ feet to 4 feet; there are usually two or three rows of wire to sustain the vines. These vines undergo extensive pruning. The Guyot simple pruning is mostly used, but there are vineyards submitted to the double Guyot pruning. The old vineyards of the watered regions consist of vines trained on tall overhead frameworks from 6 feet to 6½ feet high, and are planted in squares at a distance of from 6½ feet to 8 feet.

The vineyards of the dry grounds, old and modern, whether on the plains or on slopes and hillocks, are composed of low vines without support planted in squares at a distance of from 6½ feet to 8 feet. The height of the stems reaches from 1½ feet to 2½ feet. The old vineyards are composed of Spanish vines, the principal being the black grape called the native, or in Spanish the "Calona." There are also the "Jami Listan," the "Corazon de Buey," the "Viña de Gaelo," white, red, and black muscatels.

The modern vineyards are planted with vines from Burgundy, black Pinot, gray Pinot, white Pinot, white and black Garnet, Roman, etc., and with Bordeaux vines, such as cabernet, sovignon, cabernet-francocotrouge, berdean, merlet, white sovignon, white loca, etc., and the chasselas also is used. The modern or French vineyards are generally very well cultivated; the care taken with the soil and with the vines leaves nothing to be desired. From this point of view they will bear comparison with the best vineyards of Europe.

The harvest is as follows: (a) Irrigated vineyards.—From 60 to 100 hectoliters of wine are harvested from each hectare (from 528 gallons to 880 gallons per acre). The modern vines produce more than the old vines. (b) Vines on unirrigated lands.—The average production amounts to 30 or 40 hectoliters per hectare (264 gallons or 352 gallons per acre). The average of the annual production for the whole of Chile is estimated at from 2,000,000 to 3,000,000 hectoliters of wine (44,000,000 to 66,000,000 gallons). Wine-making is only carried on by the vineyard proprietors in the special buildings owned by each vineyard.

The wine-making industry which has as its basis the buying of the grapes from the vine growers has not yet been introduced into Chile. During the last few years there have been constructed in the greater part of the modern vineyards special buildings for making and

maturing vines. These edifices, which are sometimes very elaborate, represent a considerable capital, and burden the property, and also increase the cost price of the product. The vintage takes place during March and April. The form of the buildings, the utensils and special apparatus, the earthenware distillers, and the methods that are in use on the modern vineyards are the same, more or less, as in Bordeaux. In the last few years, new scientific systems for making wines have been introduced with excellent results, nevertheless the production of wine has not yet reached in Chile the degree of perfection that is found in the best wine production of the present time.

The principal types of wine made in this country are—Table wines, white and red, similar to those of Bordeaux and Burgundy. From the native grape is made a kind of light red wine, called "mosto," and also a wine imitating port. Furthermore, there is made from the same grape a fermented wine, called "chicha," which is the popular wine of the country. The care and maturing of the wines are the same as in Bordeaux. The commonest wines are consumed in the country. The finer wines are matured in the warehouses for three or four years, and are sold in bottles generally by the owner of the vineyard, and with his special trade-mark.

Up to the present, almost the whole of the Chilean wines have been consumed in the country, but in a short time, when the new vineyards, recently planted, reach their maximum production, Chile will, it is said, become an important exporter. Several attempts to export Chilean wines have been recently made, especially to Germany, France, England, United States, Brazil, Argentine Republic, and the Pacific Coast. During the last 15 or 20 years, Chilean wines have been prominent in the principal exhibitions of Europe and North America, and in all these exhibitions they have obtained prizes. Whenever the Chilean wines have beeen displayed in the principal exhibitions of Europe and North America, and in all countries where Chilean wines have been represented, they have been found to be of excellent quality; and if the current of exportation has not yet been established, it is principally due to the high price of the article in Chile and to the lack of cheap transport. At present the ordinary wines are sold at prices varying from 6d. to 11d. per gallon. The value of the buildings for wine making, with utensils, apparatus, large earthenware jars, etc., reaches a sum more or less equal to the corresponding value of the vineyard. This circumstance, added to the fact that the wine industry is not divided into the branches of "growers" and "makers," adds to the expense of production, whereas, in a country so privileged as Chile, it should be made in a much more economical way. The pitchers of aguardiente, or brandy, and wines of superior quality that are obtained in Chile amount annually to 1,100 gallons of 50 per cent. strength. This liquor is consumed in the country.

From the muscatel grapes is made a kind of special aguardiente called "Pisco," that has the taste and bouquet of the muscatel. "Pisco" is much prized as a liqueur of the finest quality, and should repay, says the Consul-General, its introduction into the British empire. It is specially appreciated in the north of Chile, the mining region, where it has the largest consumption. In the Huasco and Elgin valleys the muscatel grape of Alexandria dries itself and produces most excellent raisins.

COLLODIO-CHLORIDE EMULSION.

By C. T. SUTTON.

UNDOUBTEDLY the manufacture of a collodio-chloride emulsion is a much more difficult operation than is the preparation of a gelatino-chloride, on account of the difference in the solvents; for water being the most universal solvent, and nearly, if not all, the salts used in emulsion work being soluble in water, it is a comparatively easy matter to choose from among the large number of suitable salts, and many variations may be made; but, as alcohol-ether is the solvent in collodion, the choice is very much more limited.

The usual ingredients in a collodio-chloride emulsion are collodion, silver nitrate, an alkaline chloride, and a preservative.

As with gelatino-chloride, the selection of the colloid is a very necessary item in collodio-chloride, and to make it successfully, the proxyline must be carefully studied, likewise the specific gravity of the ether and alcohol, or no definite result will be obtained. For making up collodion, 0·720 ether and 0·820 alcohol should be used, thus insuring as little water as possible in the emulsion, a very important item to consider, for water tends to destroy the strength of a collodion film. Methylated alcohol can be used for making collodion, provided it is methylated with wood spirit, and not with mineral naphtha. Before using methylated alcohol for collodion, mix the alcohol with water, and if it keeps bright and colorless it may be safely used, but if on the addition of water the alcohol becomes cloudy, it must be rejected. It is rather difficult to obtain alcohol commercially methylated with wood spirit, and that is why absolute alcohol is generally recommended, but in quantities this is quite out of the question on account of the expense. Alcohol methylated with wood spirit can be procured under an inland revenue license, which may be obtained cheaply, and is generally readily granted, provided a guarantee is given that it will be used for manufacturing purposes only. Under this license methylated alcohol of 0·820 specific gravity may be obtained, which is a good strength for collodion; a higher specific gravity than this should not be used, on account of the extra water it contains, the aim in a collodio-chloride emulsion being to keep the water down to the lowest possible limit.

Pyroxyline is only supposed to be of two varieties, the high temperature and the low temperature, and while this is true in substance, it is not so in fact, for both high and low temperatures vary considerably. The success of collodio-chloride largely depends upon the pyroxyline employed, and, unfortunately, the writer has not been able to discover a commercial pyroxyline which is exactly suitable for collodio-chloride without further treatment; but, fortunately, there is a process by which one commercial kind can be made eminently suitable. It is a great pity that low temperature pyroxyline cannot be used as it is, for a very strong film could be obtained; but once the film of low temperature pyroxyline dries, no toning will take place, as the silver salts seem to be locked up in the film. High temperature pyroxyline, on the other hand, gives a film which can be easily worked when dry, as it is very porous, but the disadvantage is that it is rather rotten and cracks. What is required for collodio-chloride is something midway between the two, combining the porosity of the high temperature with the toughness and strength of the low, and, unfortunately, this is not obtainable commercially. But, if a good and suitable low temperature pyroxyline is dissolved in ether alcohol, precipitated by water, dried, and redissolved, a very strong and porous film is obtained. The question is merely one of expense, and at first sight this seems a stumbling block, but fortunately is not so in reality, for some of the low temperature pyroxyline is very soluble, twenty to twenty-five grains dissolving in fluid ounce of ether-alcohol, and even with the latter the alcohol may predominate, also ether of 0·730 can be used. With the better class low temperature pyroxyline, a quarter pound may be dissolved in forty-five ounces of 0·820 alcohol and thirty-five ounces of 0·730 ether; this, of course, makes a thick, glutinous collodion, but one that is fairly workable. It should be left to thoroughly dissolve, and then either slowly poured into a fairly large body of water, or, better still, into a small wooden trough down which a small stream of water is playing. It is advisable to pour the water and pyroxyline into a canvas bag, as it is rather difficult to collect the pyroxyline otherwise; it should then be squeegeed and drained of as much water as possible, and thoroughly dried before dissolving again. The solution is usually of a very pale yellow color. It is not exactly understood what change takes place in the pyroxyline when it is washed or precipitated, but the hypothesis is that some water enters into combination with it; at any rate, that some chemical change does take place is proved by the absence of contractility after precipitation.

The addition of a small quantity of castor oil and Canada balsam is considered to reduce the contractility of collodion, but the writer advises discretion in the use of Canada balsam, as it has an effect upon the color of the image.

Commercial collodion, as generally made up of five to six grains per ounce of ether-alcohol, is not much good for collodio-chloride work, and it will be found necessary to use about nine and a half grains of precipitated pyroxyline per ounce of ether-alcohol; and as large quantities of alcohol must be added with the silver chloride and organic preservative, it is advisable to make the collodion as follows at first:

Pyroxyline	95	grains.
Ether 0·720	5	fluid ounces.
Alcohol 0·820	4½	" "

Thus allowing half an ounce for the extra alcohol in the salts.

In the choice of a chloride we are limited to about three, viz., calcium, lithium, and strontium; or, perhaps, as Mr. C. J. Leaper advocates in his First Principles of Photography, hydrochlorate of cinchonine may be used, although the writer cannot personally recommend this, as he has not found it work very successfully, perhaps owing to some mistake in the hydrochlorate, although purchased from one of the best and most reliable firms in the chemical trade; or it may be a printer's error in the formula, the quantity given being excessive. But be the cause what it may, although the writer has made many attempts with greatly reduced quantities, the alcoholic solution of the hydrochlorate always being perfectly clear and bright on emulsifying, nothing but a heavy white precipitate has been obtained, so that the writer cannot recommend it from personal trial, although, as the nitrate of cinchonine is not deliquescent, and the nitrates of the above mentioned metals are, a great advantage would be obtained by using cinchonine, for greater immunity from damp would be secured—an important item where paper has to be kept. It is necessary when choosing a chloride to study the color of the image which each gives before deciding. Taking the three aforesaid chlorides, calcium gives a dark blue, lithium a medium red, and strontium a light red print. The writer prefers to use either lithium or strontium, as it is necessary to get a print as red as possible, and for this purpose the best would be strontium; but unfortunately it is not very soluble in alcohol, unless the latter is of a high specific gravity. Alcohol of 0·820 will only dissolve about one and a half grains per fluid drachm, and if strontium is used, the alcohol in the plain collodion should be still further reduced. Perhaps the most suitable chloride is lithium, the only disadvantage being its much higher price, this being about six times that of strontium.

The preservatives generally used are citric and tartaric acids. The choice of these should be regulated by the chloride used, and before deciding upon the preservative, it is best to mix a small portion of an alcoholic solution of the chloride with an alcoholic solution of citric and then of tartaric acid, leave them to stand for some time, and note what the effect is, for if solutions of lithium chloride and tartaric acid are mixed and allowed to stand for some time, a heavy white precipitate is formed. This may sometimes account for graininess in an emulsion, which must be particularly guarded against, as no satisfactory method of filtering collodion has yet been found; and, although some writers say that graininess does not matter, or may be overcome to some extent by decanting, "prevention is always better than cure" with this evil, for evil it undoubtedly is.

As alcoholic solutions keep well, and collodion cannot be filtered, it is a great saving of time and trouble to make the acid and chloride up into stock solutions. Citric acid is very soluble in alcohol, and a solution of ten grains per drachm can be made. Tartaric acid and lithium chloride are soluble to the extent of five grains per drachm. These can be filtered before using. It will generally be found necessary to add a small quantity of castor oil to the collodion to make it more flexible, but discretion must be used in adding this, as too much is likely to ooze out, and cause white and red spots, and lines upon the prints, for the oil will prevent the toning bath from acting. Five minims of castor oil should be mixed with half a drachm of ether, this being about the right quantity for ten ounces of collodion. The ether and oil should be added to the collodion just before mixing.

Glycerine is also a necessary addition to a collodio-chloride emulsion to keep the collodion film open and workable, and to prevent the silver from crystallizing out; but, like castor oil, it must be used cautiously, as too much will keep the paper in a damp state, thus spoiling its keeping properties.

Collodion should always be allowed to stand for a fortnight after it is made up to allow it to deposit any impurities, which will be found even in the best high temperature pyroxyline.

It is sometimes suggested that, after a collodio-chloride emulsion is made, it should be precipitated in water and the salts washed away, but the writer is unable to see the necessity of doing so, as the emulsion answers perfectly well without washing; therefore it seems a waste of time, money, and materials to wash it.

Fifteen grains of silver nitrate per ounce of emulsion seem to be about the right quantity to give a good image, and with this about six grains of citric acid per ounce should be used to insure the emulsion keeping well. If there is an insufficient quantity of citric acid, after a few weeks the paper will show white and yellow spots, either before or after printing. The question of free silver in the emulsion is a debatable point with collodio-chloride, as well as with gelatino-chloride. A certain amount of free silver is perhaps an advantage, but too much is a great disadvantage. The safest plan is to have as little as possible consistent with obtaining a good print.

A very good formula for collodio-chloride is the following:

Collodion*	9½	fluid ounces.
Recrystallized silver nitrate.	150	grains.
Lithium chloride	20	"
Citric acid	60	"
Glycerine	25	minims.
Castor oil	5	"

Silver nitrate is very soluble even in cold water, one grain dissolving in one minim of water, and more than this should not be used, as water tends to make the film rotten; the above quantity of silver should be dissolved in two and a half drachms of distilled water, warmed to about 100° F., and then the glycerine should be dissolved in seven and a half drachms of alcohol, this is also warmed to 100° F.—not more, or the alcohol and silver will be discolored; in any case where methylated alcohol is used it is probable the solution will be slightly discolored, but not sufficiently so to affect the emulsion. The silver should then be added to the alcohol and glycerine, and it will be found that the mixture of the glycerine with the silver will prevent the latter crystallizing out, even in the coldest weather—a rather important point, as, should crystallization occur, most probably the emulsion will be spoilt. On adding the silver to the collodion a slight opalescence will be noticed. The operations up to now may be conducted in daylight, but the emulsification must be done in an orange yellow light, or, if artificial light is used, it must be either incandescent electric or a Davy safety lamp, as no naked flame must be anywhere near on account of the inflammability of ether; for the same reason no fire is permissible, either in the mixing room or in an adjoining apartment, as the fumes of ether are very heavy, descend, and are likely to travel through the crevice under the door. The light from incandescent electric or a Davy lamp does not affect the emulsion, and the Davy lamp is perfectly safe even in the densest fumes, for, should they become too strong, the light is extinguished.

If stock solutions of lithium chloride and citric acid have been made up, as before advised, four drachms of the former should now be added to form the emulsion, after which six drachms of the citric acid solution should be added, when the emulsion is ready for coating. To make sure there is no grain, it is advisable to let the emulsion stand for a quarter to half an hour before using, then carefully decant into another vessel, as by that time the larger particles should have settled down.

A glass vessel should always be used for making collodio-chloride emulsion (except in very large quantities) as the operations can be watched more easily.

Mixing a collodion emulsion is a much more delicate operation than mixing a gelatine emulsion, as silver nitrate is not really soluble in alcohols, much less ether, consequently the writer recommends the following method of mixing in preference to the usually advocated way of pouring the solutions into the collodion, following this up by shaking and stirring, for by the latter method the solutions are put in very unevenly, and the mixing is very often still more so. A glass funnel should be placed in the ring of a retort stand, a small piece of glass tubing then drawn out to a fine point, and attached to the tube of the funnel by India rubber tubing, bearing a pinchcock to regulate the flow of the solutions; into the neck of the funnel a small plugget of cotton wool should be inserted to arrest any impurities in the silver. The cotton can be thrown among the residues afterward. The solutions should be poured into the funnel separately and alternately, and allowed to flow into the collodion in a very fine stream. Of course, the funnel, etc., must be well washed out after the silver has passed through, or the chloride would be spoiled. After the washing it is as well to run a little alcohol through the funnel and tube to absorb any water which may be left. If a regular stirring is kept up with a glass rod or strip, while the solutions are streaming in, a very fine-grained emulsion should result; but a much better way is to use the little implement shown in the accompanying sketch.

The whole of this should be made of mahogany, the stem being fastened into the blade by mahogany pins, as neither glue, nails, screws nor metal pins must be used, or the emulsion may be spoiled. The end of the stem should be tapered off to fit into a socket, the friction holding it sufficiently tight, as very little power is required. It should be driven at about 150 revolutions per minute, either by hand, treadle, water, air or electro-motor, and by its aid a very fine mix is obtained with absolute certainty, the solutions traveling right through the collodion. Before using, the whole of the

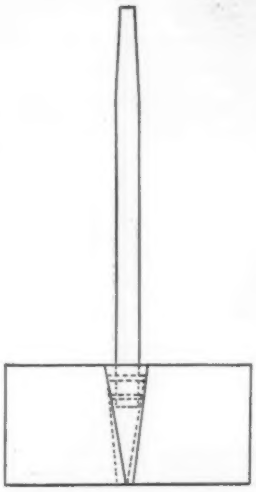
* This collodion should be made up as before advised, containing five ounces ether and four and a half ounces alcohol. In making collodio-chloride emulsions it is necessary to get the salts into the collodion in as fine a state of division as possible. The silver should always be added first, it being much easier to see that no graininess takes place. The silver nitrate should be recrystallized, as the ordinary kind is usually too acid for emulsion work.

blade and lower part of the stem should be well soaked in alcohol, to decolorize it as much as possible, and directly mixing is finished it should be placed in water, or great difficulty will be found in removing the emulsion. The mixer should be kept in the dark as much as possible, or it will be discolored. This style of mixer may be used for bromide or chloride, gelatine or collodion emulsions, but a separate mixer should be kept for each class of emulsion.

If the emulsion is properly made, on dipping a glass rod into it, and looking at the light through the bead of emulsion which collects upon the end of the rod, a rich orange color should be observed.

The emulsion must be used the same day as it is made, for it will not keep, owing to the rapid evaporation of the ether.

Collodio-chloride may be coated fairly well by hand after a little practice, if the edges of the paper are turned up to form a tray; the emulsion should be poured into this, and floated all over the paper, pour-



ing the surplus back into the containing vessel. The great disadvantage about this way is, that it allows the ether to evaporate very rapidly, thus making the emulsion thick, and the coating is then sometimes uneven. As far as the writer's experience goes, he has not found a really reliable and satisfactory way of coating by hand.

In toning collodio-chloride it should be remembered that a bath, strong in gold, gives blue tones, and it is not necessary to use a stronger bath than the following:

Ammonium sulphocyanide......	15 grains.
Gold chloride	1 "
Distilled water..................	8 fluid ounces.

The sulphocyanide bath is the best for the above emulsion.

Unlike gelatine, collodion is practically inert so far as silver is concerned, for it does not enter into combination with silver and has no effect whatever upon the color of the image, and this is probably the reason why collodion prints are the most stable of all photographs made upon printing-out papers, for a definite salt of silver is formed in collodion, instead of the indefinite gelatinate and albuminate.

In printing with collodio-chloride, if the negatives are thin, a better result is sometimes obtained by printing the image faintly, in the ordinary way, and then placing the printing frame under green glass to finish the print, when a much more plucky and vigorous image will be obtained. The theory of this is, that chloride of silver is only susceptible to the blue and violet rays, while citrate and tartrate of silver are affected by green and yellow rays as well; thus, when the print is under green glass, the chloride does not change, while the citrate and tartrate do.

The writer has had many attempts to increase the strength and tenacity of high-temperature collodion films by the addition of the following: Gum resins in small quantities, bleached lac, Canada and copaiba balsams, mastic, copal, elemi, sandarac and dammar; but the result has not been particularly encouraging so far as increase of strength and tenacity is concerned, while (probably owing to their organic nature) they exercise an influence upon the color of the image. If it is decided to use any of the above, no large quantity should be added, as they are insoluble in, and impervious to water, and no toning, or only a very little, and that of a slow nature, would take place if they were present in any large quantity. The writer has been in the habit of making a saturated solution of each of the gum resins, and adding about six minims of this saturated solution to each ounce of collodion. The saturated solutions of gum resins are very handy in the laboratory as ready-made adhesives, and, as they are all alcoholic solutions, there need be no fear that they will not keep.

A mixture of high and low temperature pyroxylines will sometimes give a good collodion for collodio-chloride work if equal quantities of each are taken, but a small portion should be tried first, as some pyroxylines do not mix well.

If it is found inconvenient to use incandescent electric light, or a Davy lamp, to illuminate the mixing room, or, as in many remote districts they are very difficult to obtain, a lamp may be placed outside the window of that apartment, taking care that it is completely isolated from the ether fumes. The one disadvantage of Davy lamps is that only a very feeble light is obtainable from them, but if all the preparations are made in daylight, this is not a great drawback.—The British Journal of Photography.

ACETYLENE AND ITS ADAPTABILITY AS A MOTIVE POWER FOR VEHICLES.

By E. C. OLIVER, Instructor in Mechanical Engineering Laboratory, University of Illinois.

ACETYLENE was first isolated by Prof. Edmund Davy in 1836, who found that in the production of potassium from potassium carbonate a small by-product of potassium and carbon remained which decomposed on the addition of water, giving acetylene. This gas he called klumene, and described it as an odorous combustible gaseous bicarburet of hydrogen. The by-product from which this was obtained was shown by Berzelius in the same year to be potassium carbide.

Considerable interest was again drawn to the gas between 1859 and 1866 by the investigations of Berthelot and Wöhler. The former obtained acetylene by the decomposition of sodium carbide produced by forming and then heating sodium acetylide. He also showed in 1866 that acetylene is formed by the electric arc in an atmosphere of hydrogen, affording the first example of the direct synthesis of a hydrocarbon. In addition to thus preparing the gas, Berthelot investigated its physical properties.

To Wöhler belongs the credit of having first obtained calcium carbide, as he formed this substance by heating to a welding temperature an alloy of zinc and calcium with carbon, and from this calcium carbide he obtained acetylene by decomposition with water, thus:

$$Ca + C_2 = Ca\,C_2$$
$$Ca\,C_2 + H_2\,O = Ca\,O + C_2\,H_2.$$

The former reaction is of the greatest importance, and is entirely due to the influence of heat.

In 1880 Dr. Borcher, while conducting some experiments in a small electric furnace, found that calcium carbide was formed by the action of calcium vapor from the quicklime lining on the carbon electrodes. After a complete study of the carbides he gave a full account of calcium carbide and its reactions in 1894, when he exhibited crystals of the carbide obtained from pure quicklime and carbon made from sugar.

At the same time T. L. Willson, at Spray, independently discovered that calcium carbide could be obtained in an electric furnace. He was endeavoring to obtain alloys of calcium, and discarded the dark product obtained, which, it was noticed, effervesced upon coming in contact with water. It was then found that calcium carbide had been produced, which upon decomposition gave acetylene.

Until this time the production of calcium carbide and acetylene had no commercial importance, owing to the high price of calcium. It was of use mostly for a study of its chemical reactions; but when the advent of the electrical furnace made possible its production in large quantities and at a comparatively low price, more attention was given to adapting it to the uses for which it was suited.

MANUFACTURE.

Calcium carbide is manufactured on a commercial scale by heating lime and carbon in an electric furnace. This furnace consists in principle of a cast iron crucible forming one electrode and containing the mixture, and a number of carbon pencils forming the other electrode. The carbon electrode is adjustable that it may be fed into the mixture as it is burned up, and the voltage kept constant. Ground coke is used as the carbonaceous material, and it is intimately mixed with finely ground unslaked lime in a proportion of 100 parts of lime to from 63 to 67 parts of coke, the percentage of coke varying with the voltage used. The current may be either alternating or direct, as the action is one of heat and not electrolysis. The voltage used varies from 65 to 100, and the current from 1,700 to 2,000 amperes.

One horse power hour is required to produce 0·3 of a pound of carbide of good quality, or about 7,000 horse power hours per ton. The great power necessary has led to calcium carbide being produced only where there is abundant water power, as at Niagara. The cost of a horse power at this place is about $18 per electrical horse power per year, and at this rate calcium carbide may be purchased in large quantities at from $75 to $80 per ton.

PROPERTIES OF CALCIUM CARBIDE.

Calcium carbide is a hard crystalline substance of a reddish brown color when pure, but owing to impurities the commercial article is of a gray or brownish black color. It has a specific gravity of 2·262.

Theoretically, 1 pound of carbide should require 0·525 pound of water for its decomposition, and give 1·1563 pounds of lime and 0·4064 pound of acetylene, measuring 5·903 cubic feet at 60° F. and atmospheric pressure; but it has been found more economical to manufacture a carbide giving about 5 cubic feet of gas per pound.

Upon decomposition 1 pound of calcium carbide gives out 900 British thermal units, and this heat must be taken into careful consideration when devising generating apparatus, owing to the low temperature at which acetylene is decomposed, and also in order that the impurities contained therein (sulphureted and phosphureted hydrogen and ammonia) may not be volatilized and contaminate the gas produced.

GENERATING APPARATUS.

The various types of generators used may be divided into classes as follows: Those in which the carbide and water are brought into contact with each other by the change of level of one of the substances; those in which the water is allowed to fall on the carbide drop by drop or in small quantities, and those in which the carbide is added bit by bit to a large quantity of water. These classes may be also divided into those generators which act automatically and those which depend on the operator for manipulation.

Of each class there are a number of forms made, but the most promising perhaps is the last mentioned class, for in this the large body of water will most effectually take up the heat generated, besides absorbing to some extent the impurities given off.

STORING ACETYLENE.

There are three general ways in which acetylene may be stored: 1. By keeping it latent in calcium carbide and generating it as needed. This method has the advantage of safety and convenience in handling, but there is sometimes considerable loss due to the after generation of the gas, unless there be means used to store this gas for future use, which may not always be possible.

2. Acetylene may be liquefied at 97° F. by a pressure of 68 atmospheres, or at 68° F. by a pressure of 42·8 atmospheres. In this state one volume of liquid acetylene will produce 340 volumes of free gas. It is the lightest liquid known, having a specific gravity of 0·4, water being 1, and has also the greatest coefficient of expansion known for any liquid or solid, one volume at 32° F. expanding to 1·24 volumes at 96° F. In addition to these properties, liquid acetylene may be fired by a spark or incandescent wire, and then has all the characteristics of a modern explosive.

Under these conditions then it may be said that although when carefully handled acetylene may be stored in this manner, yet it does not offer sufficient promise to make it popular.

3. At 59° and atmospheric pressure, acetone ($C_3\,H_6\,O$) is capable of absorbing twenty-five times its volume of the gas, and this property of taking acetylene into solution rises nearly in proportion to the pressure between 32° and 95° F. At 12 atmospheres 1 volume of acetone absorbs 300 volumes of acetylene, and the consequent volume is 1·48 at this pressure.

Messrs. Berthelot and Vieille, who have made investigations concerning this mixture, found that when the pressure did not exceed 28 pounds per square inch and the temperature 60°, a cylinder containing acetone saturated with acetylene was not exploded even with a fulminate cap. From this pressure up to a pressure of 142 pounds per square inch, the mixture was explosive, but the pressure of explosion was not greater than that of pure acetylene under the same conditions.

This field probably offers the most promise of any method now known of storing the gas. It is possible to carry a considerable supply without an especially weighty reservoir, and it is practically safe.

EXPLOSIVE PROPERTIES.

Acetylene and air at atmospheric pressure will burn when mixed in any proportions between 2·7 per cent. and 95 per cent. of acetylene, while between 4 per cent. and 67 per cent. an explosion takes place, being most violent when there is about 8 per cent. of acetylene present.

Acetylene alone will not explode until the pressure is increased to $1\frac{1}{10}$ atmospheres, but above this pressure it is violently explosive; consequently, it should not be kept under a pressure of more than a few inches of water.

The results of a series of experiments made to ascertain the maximum pressure of explosion of this gas under various pressures are given in the following table:

PRESSURE IN ATMOSPHERES.

Initial.	After Explosion.
2·15	8·50 : 10·44
3·38	18·00 : 18·71
5·78	40·04 : 42·03
10·87	89·76 : 88·80
20·45	206·77 : 205·70

For its mixtures with air in varying proportions, Grehant has made numerous experiments, the results of which he states in the following table, and which are for atmospheric pressure:

Acetylene 1, air 1—Burns with sooty flame.
Acetylene 1, air 2—Burns with sooty flame.
Acetylene 1, air 3—Explosion with sooty deposit.
Acetylene 1, air 4—Explosion without sooty deposit.
Acetylene 1, air 6—Strong explosion.
Acetylene 1, air 9—Strongest explosion.
Acetylene 1, air 12—Strong explosion.
Acetylene 1, air 19—Weak explosion.
Acetylene 1, air 20—Inflammation without explosion.
Acetylene 1, air 25—Inflammation without explosion.

In a recent paper by M. Ravel he states that the temperature required to explode this gas is but 900° F., whereas it requires 1,100° F. to explode any mixture of coal gas and air; also, that the temperature of explosion reached 7,200° F.

ITS USE IN MOTORS.

Authorities differ regarding the expediency of using acetylene in motors, and numerous experiments have been carried out, with varying results, to determine its usefulness.

A report in La Revue Industrielle of some tests made by Cunat with engines of from 8 to 16 horse power states that acetylene was used in these engines with no other change than to diminish the size of the inlet valve, and that when used in a mixture of 10 of air to 1 of gas, acetylene gave three times the energy of an equal volume of coal gas, developing a horse power for 6 cents per hour.

M. Ravel with a 2 horse power motor was able to obtain a horse power hour on 6·35 cubic feet of acetylene, using a mixture of 15 air to 1 of gas. This gave about 2·1 times the energy of coal gas. In another engine he could not use a greater proportion of gas than 5 per cent., due to the high compression, and noted that while the explosion pressure was extremely great, yet the fall of pressure was immediate and expansion was not carried out.

These experiments are of value to us, as they point out some of the difficulties in using acetylene as a motive power, and also suggest some improvements which might be made in the design of motors intended for the more effective and economical use of this gas.

The following points regarding the behavior of the gas need to be especially noted: 1. The low ignition temperature. 2. The great rapidity of the transmission of flame. 3. The high combustion temperature. 4. The extraordinary energy evolved by the explosion. 5. The wide range of its explosive mixtures.

A motor designed for the use of this gas should be built with the object of eliminating as far as possible the ill effects due to these characteristics without impairing the properties which may be of value in the economical working of the machine.

It is evident from the foregoing that to avoid premature explosions the cylinder must be kept at a temperature lower than the ignition temperature of the mixture when compressed. This would necessitate a water-jacketed cylinder even in small sizes on account of the extremely high temperature of the combustion

On the other hand, the low temperature of the cylinder walls would greatly lessen the effective pressure of expansion, as the cooling effect of the walls on the gas would be very marked. It would, however, be impossible to avoid this action. The only way to increase the efficiency would be to increase the speed of rotation, this giving less time for an exchange of heat between the gas and cylinder walls.

The increased shock on the parts of the engine due to the greater pressure of explosion would necessitate greater area of bearing surface at each end of the connecting rod and in the main bearings of the engine shaft, as well as a stiffer construction throughout.

FIG. 1.—VERTICAL MICROPHOTOGRAPHIC APPARATUS.

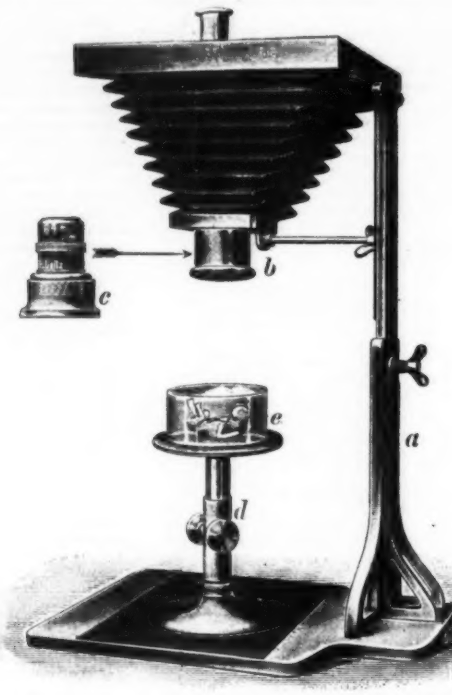


FIG. 2.—MICROPHOTOGRAPHY OF OPAQUE OBJECTS.

This would, however, be partially arranged for by giving the engine less pressure of compression by increasing the per cent. of clearance or by other means, thereby lessening the force of explosion and consequent shock on the parts.

The great range of explosive mixtures would lend itself very readily to the control of the speed of the motor by an adjustment of the supply of gas.

That acetylene may be used as a motive power is assured, but whether it will prove popular cannot at present be stated. It has many of the desirable qualities of gasoline, but at present is more expensive, and the motor in which it is used would probably be subject to more wear and consequently more repair than if used with its milder rival.

The acetylene motor must necessarily spend a considerable time in the experimental stage, and with the knowledge gained from other explosive motors it is not unlikely that one may be built which will prove not only successful, but popular.—Horseless Age.

MICROPHOTOGRAPHY AS AN AID IN SCIENTIFIC RESEARCH.

By Dr. CURT SCHMIDT.

RICHER and more varied in its forms than the firmament swarming with stars overhead is the microcosm, the world of the infinitely small, the world which the penetrating eye of the microscope reveals to the scientific investigator. The plan of fixing upon a photographic plate images of the manifold forms to be found in this miniature world was first broached by François Arago in the memorable meeting of the French Institute of August 19, 1839, in which he explained Daguerre's grand invention to the learned members and proposed to photograph the heavens.

The first microphotographs were made by projecting an image of the object to be photographed upon a plane, white surface by means of the solar microscope, and by photographing this projected image on a reduced scale. Some experimenters threw the image directly on the photographic plate, the room having previously been darkened. As early as 1840, A. Donné exhibited before the Parisian Academy photographs made in this way. In 1845 he published with the collaboration of Léon Foucault an atlas of the humors of the human organism, the numerous illustrations of which atlas were produced with the aid of daguerreotypes made by means of the solar microscope.

Early in the history of microphotography scientific men tried to dispense with a darkened room and an auxiliary camera. Microphotographic apparatus of various types were invented, the earliest of which was the photomicroscope devised by the Frankfort druggist Mayer, in 1844. It is not my purpose in the present article to trace in detail the historical development of microphotographic apparatus, but to describe our modern instruments of precision. For that reason I must leave to others the chronicling of the steps in the evolution of microphotography.

Our modern instruments for photographing microscopic objects may be roughly divided into vertical and horizontal apparatus, each type having certain merits distinctly its own.

Among the cheapest and simplest arrangements are the vertical apparatus illustrated in Figs. 1 and 2. Upon an iron base-plate a standard is mounted, provided with guideways which receive a slidable camera support. By means of a wing-screw the support is held in any position in the standard-guides. The camera bellows can be contracted or expanded to bring the ground-glass in the focus of the lens and can be fastened in adjusted position by means of a set-screw. Diaphragms are employed to cut out those parts of the field not to be photographed. The image is sharply focused by means of a focusing-glass mounted above the camera.

After the prepared object to be photographed has been placed upon the stage, the microscope is moved beneath the camera with the tube below the bellows. Over the eye-piece of the microscope and the small end of the bellows a flexible cloth is slipped, which excludes all light. To one side of the microscope a Weisbach burner is placed, the light from which passes through a condensing lens, falls upon the mirror of the microscope, and is reflected upwardly to illuminate the object on the stage (Fig. 1). Instead of a Weisbach burner, the light of the sun can be employed, in which case the condensing lens is dispensed with and a ground glass employed as a substitute to diffuse the rays. The apparatus is first adjusted to obtain an image of the proper size. Thereupon the coarse-adjustment screw is turned through the proper distance to bring the image approximately in focus on the ground glass of the camera. The ground glass is then removed and a sheet of plain glass substituted, in the middle of which a cross has been cut. Upon this cross the focusing-glass of the camera is brought to bear. The image observed through the focusing glass is brought sharply into focus by means of the fine-adjustment screw of the microscope. In order to ascertain whether the object is permanently in focus, the apparatus is left undisturbed for about fifteen minutes. If, after that time, the image has vanished or has become indistinct, the object must again be focused. The chief cause of disadjustment is to be looked for in the contraction and expansion of the microscope parts as well as of the object on the stage, and in the elastic reaction of the fine-adjustment screw, which reaction, though it be ever so small, is nevertheless sufficient to destroy the focus of an object magnified 1,000 times. When it has been found that the image is permanently sharp, the glass is removed from the back of the camera and the plate-holder containing the sensitive photographic plate substituted. The microscope-mirror is then covered and the slide of the holder drawn out. During the time of exposure, the microscope-mirror is uncovered.

The camera can also be used in making magnified pictures of opaque organisms, such as insects and embryo structures, without the microscope. A lens of suitable construction—in Fig. 2 a Leitz periplane is shown—is inserted in its proper position in the camera, and the object to be photographed is placed upon an adjustable support.

A microphotographic apparatus which requires the utmost precision in its optical and mechanical adjustment, which possesses the merits of both vertical and horizontal micro-cameras, has been designed by Zeiss of Jena (Figs. 3a and 3b). On a triangular base, *F*, the plate, *P*, adjustable by means of the set-screws, *i*, is mounted. The plate, *P*, supports a microscope which can be held in adjusted position by the clamp, *m*. The front and back of the camera can be independently moved and clamped on a vertical guide-rod mounted on the base, *F*. The light-tight connection between the camera and the microscope consists of a tubular member on the front-board and a second tubular member surrounding the eyepiece of the microscope, the two members being designed to lie one with-

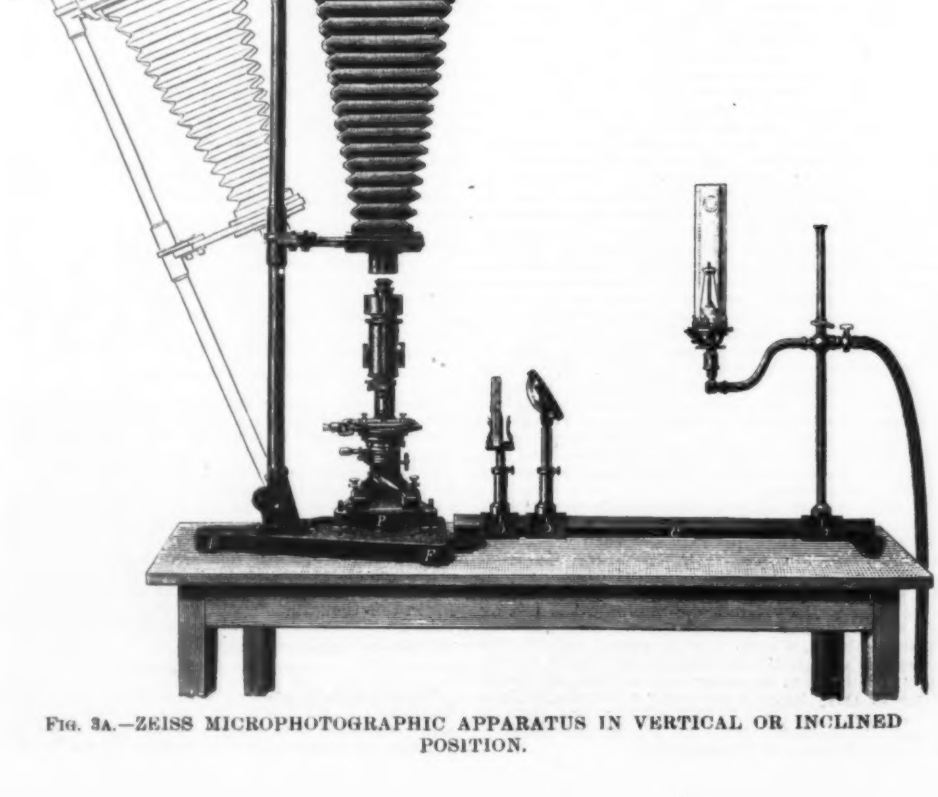


FIG. 3A.—ZEISS MICROPHOTOGRAPHIC APPARATUS IN VERTICAL OR INCLINED POSITION.

in the other and to form a light-tight joint. The guide-rod is pivoted at its lower end, so that the camera can be swung from vertical to horizontal position or vice versa. An optical bench, o, is provided, on which a Welsbach burner, condensing lens, *S*, light-filter, *C*, iris diaphragm, *I*, are mounted.

Often a microphotographer is confronted with the task of slightly magnifying transparent objects which are so large that they cannot be covered by the microscope-objective and which cannot be taken by an ordinary camera. For such cases the Edinger-Nieser apparatus illustrated in Fig. 4 is employed. With this camera prepared objects up to 35 mm. in diameter can be photographed. Upon a polished wooden base an adjustable standard is mounted, provided with a condensing-lens and a mirror, and with a movable stage driven by rack and pinion. The standard carries a reflector-lamp. The light of the lamp is concentrated upon the mirror by the lens and reflected upon the object on the stage. The camera is provided with a small slide or cover, which when pushed aside or removed, permits the photographer to bring the image into focus. Diaphragms are used to secure good definitions.

As a general rule, any microscope provided with an accurate adjusting mechanism can be used in microphotography. Zeiss of Jena has designed a new instrument for general as well as for photographic use, which may be regarded as the most complete and improved apparatus of its kind. The microscope (Fig. 5) is provided with a stage so large that objects of considerable size can be examined with the strongest objectives. The stage can be rotated on its center and the object-slide moved through minute measurable distances. The instrument is provided with a tube, *T*, of large diameter, which serves to overcome the indistinctness usually caused by internal reflection of light. To secure very fine adjustments at high magnifying powers the micrometer movement, *W*, is used.

The preparation of objects for microscopic examination, owing to the focal differences in objectives, caused no little difficulty in the early days of microphotography. The human eye is extremely sensitive to yellow light and far less so to blue and violet rays. The photographic plate, on the other hand, is more sensitive to violet and blue than to yellow light. Moreover, the rays of various colors are not refrangible to the same extent, so that it is difficult to bring all the rays to a single optical focus, thus causing the rays to which the eye is sensitive, viz., the chemical rays, to meet at a point without the focus of the lens. If a photographic plate be placed at the focal point of the optical rays, a very indistinct negative would be obtained. To overcome the obstacle special photographic objectives have been made, which are designed to bring the optical and chemical rays to a common focus. Such objectives are called apochromatic lenses and are exceedingly costly. The invention of orthochromatic photographic plates and the use of color screens have also assisted in avoiding the difficulties presented by the focal differences of objectives.

Microphotography is far more trustworthy than drawing; for the reason that it can make no mistake. The photographic plate is more efficient and more sensitive than the retina of the human eye. Not only is the human eye easily fatigued, but it is also unable to perceive differences of illumination beyond a certain limit. The photographic plate is never fatigued. It is true that the plate is also sensitive to light only of a certain intensity, but the limit beyond which no chemical action takes place in the silver is much lower than the limit of vision of the human eye. By correct exposures it is possible to photograph details which are imperceptible to the eye. Dr. Neuhauss succeeded in proving the existence of funicules in the comma-bacilli of Asiatic cholera. Every possible stain was employed; but no funicules could be seen. Dr. Neuhauss therefore resolved to employ the camera. A goodly number of plates had been sacrificed, and the attempt almost given up in despair, when one of the negatives revealed a short, sharply bent bacillus, from which there extended a fine, corkscrew-like funicule. Further experiments were made; photographs of the same slide were made from different points of view; other bacilli were found with funicules. It was not until Neuhauss had photographically proved the existence of these cholera funicules that Löffler succeeded in detecting them with the eye, in a specially stained slide.

It would be impossible in the brief space of the present article to review all the applications of microphotography. How important is the influence which this new art has exerted even on modern law is admirably told by the well-known Berlin chemical expert, Dr. Jeserich. In the hand of a murdered man hairs were found which in the death struggle had been torn from the head of the murderer. Two men were accused of the crime; the hair of each was carefully examined, and that of one of the accused men, when microscopically examined, was exactly the same as that clutched by the dead man. The evidence was incontrovertible.

It is well known to every photographer that the salts of silver are extremely sensitive to rays of short wave-length. The microcamera may therefore reveal unthought of wonders if the ultra-violet rays, to which the human eye is not sensitive, be employed. It may be that with light of such short wave-length, structures far more curious than bacteria funicules may be discovered.

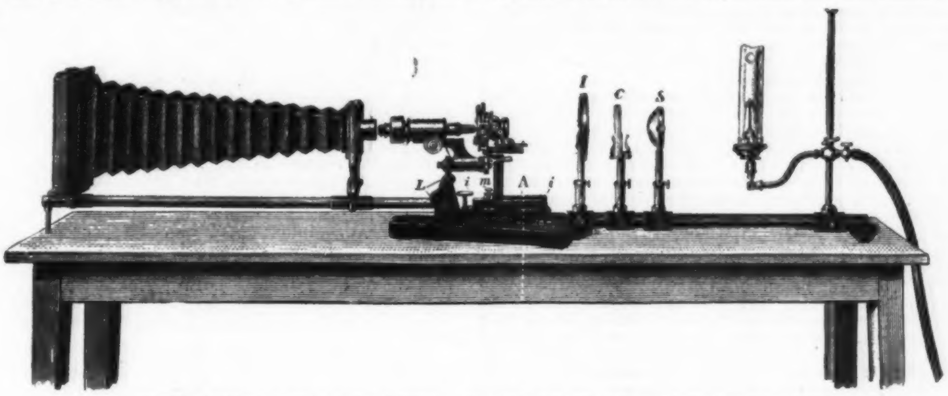


FIG. 3B.—ZEISS MICROPHOTOGRAPHIC APPARATUS IN HORIZONTAL POSITION.

FIG. 5.—ZEISS MICROSCOPE FOR PHOTOGRAPHIC USE.

FIG. 4.—EDINGER-NIESER CAMERA.

RESULTS OF EXPERIMENTAL WORK IN AGRICULTURE IN CANADA UNDER GOVERNMENT ORGANIZATIONS.*

FOR some years prior to 1884 agriculture in Canada was in a depressed condition, and during that year a Select Committee was appointed by the House of Commons to inquire into the best means of encouraging and developing the agricultural industries of Canada. From the investigations of this committee it was shown that farming in Canada was at that time in a very defective condition, that there was a lack of thorough tillage, that no sufficient measures were taken to maintain the fertility of the soil, that there was a want of knowledge in regard to rotation of crops, and of the selection of improved varieties of seed; that lack of information existed also in reference to many of the principles underlying the successful rearing of stock, the manufacture of dairy products, and fruit growing.

This committee recommended that the government establish an experimental farm where experiments might be carried on in connection with all branches of agriculture, horticulture, and arboriculture, and that the results of these experiments be published from time to time and disseminated freely among the farmers of the Dominion.

In 1886 an Act was passed by the Parliament of Canada authorizing the government to establish a central experimental farm and four branch experimental farms in different parts of the Dominion, and during the two years following these farms were established and set in operation. The results of twelve years' experience have shown that these institutions have been highly beneficial to the farming community. Experimental research has been carried on along the lines prescribed by the Act by which these farms were established, and much information has been accumulated and distributed freely to the farmers of Canada in reports and bulletins. Benefits have thus been conferred on Canadian farmers in connection with all the more important farm crops, in the development of the

* Abstract of a paper read before Section F of the British Association at Bradford, by William Saunders, LL.D., Director of Canadian Experimental Farms.

stock and dairy industries, in the production of fruits, in the growing of trees for shelter and timber, and in the advancement of other branches of arboriculture.

Much attention has been given to experiments relating to the maintenance of the fertility of the land, to the best methods of cultivating the soil, to a proper rotation of crops, to the best time for sowing, and the selection of the best and most productive varieties for seed. By freely spreading the information gained, supplemented by a liberal distribution of samples of the best and most productive cereals, crops have been improved, and the attention of farmers generally awakened to the importance of adopting such measures as will result in increased crops. The steady advancement which has taken place within recent years in Canada and the increasing prosperity of agricultural industries may in large measure be attributed to the useful work of these experimental farms established and maintained by the government in different parts of Canada.

THE BALALAIKISTS.

IN Russia there are certain first-class musicians who have formed themselves into an orchestra, and who, upon popular instruments, interpret pieces of which the rhythm and the manner of playing are so novel as to upset all the ideas that we have held as to music. They enjoy a great reputation in their own country. The Czar, who holds them in high esteem, takes the greatest delight in listening to them, and it was at his desire and at his own expense that they visited the Exposition, in order to show Paris the wonderful art resources that may be found among the Slavonian people.

The instruments and the melodies that allow us to appreciate the orchestra of the Balalaikists had to be sought for in the rural districts; but, like the live forces of nature, they required to be rehabilitated in order that they might produce all the effects of which they are capable. So this music that comes to us from the North has been refined and put in symphony, the instruments have been improved, and the melodies that we now have are charming and faultless, since they are rendered by artists of incomparable talent.

In order to collect all these popular songs, from even the remotest districts, the Imperial Geographical Society of Russia organizes expeditions, during the course of which the airs that are found are registered, and from the material gathered a selection is made of those that are capable of giving interesting morceaux. In this way more than five hundred songs have been collected, although all have not been preserved. Those that have been preserved have been intrusted to competent musicians, who have harmonized them and arranged them especially for the orchestra of the Balalaikists.

It is evident that the best instrument for the interpretation of such music is that upon which it is played in the country districts, that is to say, the "domra," the "balalaika," the "gousli," etc.; but as such instruments are primitive, it became necessary to retouch them likewise, in order to give them all the sonorousness and timbre desired. So, if the musicians under consideration charm and astonish us, it is because they present us with new airs upon new instruments. The symphony of Russian airs is not the same as ours. Thus the gamut, instead of presenting the succession of notes with which we are familiar, consists of the following seven:

do re mi fa sol la si

The result is consonances to which we are not habituated, and which, while harmonious and captivating, astonish us and seem odd.

The instruments of the orchestra are the "domra," the "balalaika," the "gousli," the "bleicka," the "svireli," the "nacri" and the "boubenne."

The domra, of which there are four different sizes, and which consequently gives four consonances, is a descendant of the ancient Egyptian tambour, a prototype of the "mandolin" among the Italians, of the "tambouritza" among the Hovas, of the "saase" among the Persians, etc. This instrument has but three strings, two of which give the *mi* and the third the *la*. They are made to vibrate by means of a small piece of bone of special form. The arrangement of its resonator and handle make of it a very particular type, which in no wise resembles its similars. Its origin is Oriental and it did not appear in Russia until the sixteenth century; but it has been converted into another instrument, the "balalaika," properly so called, which is really the popular instrument of Russia. The form of this is triangular, and, like the "domra," it is provided with three strings. It is played by striking all the strings with the hand (Fig. 1).

It is made in various sizes, and there is one which is very bulky and replaces the counter-bass of our orchestras (Fig. 2).

This instrument is held in great honor in Russia. It has, however, required time to develop and improve it, on account of the severe Byzantine regulations and religious persecutions of mundane music between the eleventh and eighteenth centuries; but to-day we keep pace with progress, and the reformed "balalaika" is tending to come further and further into use. The Czar of Russia is himself endeavoring to popularize it as much as possible and has caused the playing of it to be taught in the army. The soldiers experience a singular pleasure in listening to the sounds and melodies of their villages. They very quickly learn how to play, since the instrument is easy.

The "gousli" is the most ancient musical instrument of the Russian people. It was invented by the Slavonians and has been known since the ninth century. The primitive gouslis had but nine strings. The manner of playing it is to form accords, so that the instrument is capable of serving only for accompaniments, like the guitar. It is played by striking with the hand all the strings at once that compose the accord. The instrument, which has been improved, presents the form of a horizontal harp, and the number of strings is 64, tuned chromatically.

The "bleicka" bears considerable resemblance to the shepherd's clarionet. It serves as a complement to the "svirelis," which consist of two cylindrical tubes that are introduced at the same time between the lips and both blown at once. The "svirelis" have been known in Russia ever since the eleventh century.

Finally, we have the "nacri," which is a sort of terra cotta pot. It came from the East and has been known since the sixteenth century. The "boubenne" has nearly the same form as our tambourine.

The orchestra of the Balalaikists consists of persons who in ordinary times practice liberal professions, but who unite for musical purposes. It was difficult for them to play at Paris before a miscellaneous paying audience, since they had been accustomed to perform only in select society, where they were certain of being understood and appreciated.

A large portion of the merit of this corps of artists belongs to its leader, M. Andreeff, who is the true renovator of this popular Russian music. It is he who improved the instruments and gave them their present form, and it is he, too, who, by his ardor and superior talent, gave his coadjutors that sacred fire and that perfection of execution that have converted them into the most unique orchestra in the world.—For the above particulars and the engravings, we are indebted to La Nature.

FIG. 1.—A TYPICAL BALALAIKA. FIG. 2.—MODIFIED FORMS OF THE BALALAIKA.

THREE AMERICAN TYPES REDUCED FROM PHYSICAL MEASUREMENTS.*

THIS is an age of testing and measuring. It is a time when men are seeking for exactness, both in method and in results. It is not strange, then, that persons studying the human body should use measurements for recording results of observations for comparative studies.

The question has often been asked as to whether the improved hygiene of the present day would leave a trace in the physical betterment of the race that could be stated or estimated mathematically. Such a result has been doubted by some of the ablest physiologists of the day, it being believed that the racial type had become so fixed that the comparatively slight changes that could be made in methods of living would be impotent in making radical physical changes. Recently a study of the measurements of the female students in one of the Western universities, covering a period sufficiently long to secure 1,500 individual records, has been published. This table, with one of similar character from the Middle West, and a previous one from the East, covering a group of similar size and similar age and occupation that was published by Miss Wood of Wellesley College, forms the basis of this paper.

About 1891 Miss Anna M. Wood published a percental table showing the grouping of Wellesley students to the number of 1,600, according to their physical sizes. This was the first table of the kind that had ever been published; although a table had been prepared in 1888 in percental form giving a tabulation of 2,300 Yale students. In 1894 Dr. Hanna, of Oberlin College, published a percental table of 1,500 women whom she had personally measured in that college. These two tables give a fair means of making a comparison of the physical type of young women of college age in the New England States and in the Middle West. Each of the institutions had representatives from both East and West in its group of students; but the majority of them could be classed from that locality where the college is situated. In June, 1899, Miss Anna M. Barr, of the University of Nebraska, published a table showing the physical standards, by heights, of the 1,500 women whom she had measured in that university. The patronage of this State university may fairly be assumed to come from the region west of the Mississippi River; and all three colleges have drawn their students largely from Anglo-Saxon stock, although a fairly large sprinkling of Teuton blood will be found in each one, as indicated by the names on the catalogue lists—this percentage being somewhat larger in the University of Nebraska than in either of the other institutions.

Whatever change in size and physical type may be disclosed by these tables, may be properly attributed to the methods of life and environment, and not to racial peculiarities. It may be said that the Eastern college draws a much larger percentage of its patronage from urban population; while the more Western institutions represent types that live more out of doors, and are engaged in more active physical employments. With this explanation, let us glance at some of the physical peculiarities that are disclosed by these tables.

I have prepared these two charts to show, in a graphic way, what I think is pretty well established in a mathematical way. This upper chart here is called the Nebraska standard: that is, the two graphic lines that you see here in red and blue show the measurements of Wellesley students; the red, of Oberlin students; the blue on that chart there is the standard for Nebraska women. In other words, this 50 per cent. or average line, running through the middle, represents the same thing for Nebraska students that the red line does for Wellesley students and the blue line for Oberlin students. You notice here the items of record that are made—so much of it as being lengths; then this distance being girths—various items like head, neck, chest, waist, hips, biceps, forearm, thigh, calf, etc.; here the distance covering breadths, then depths, and this final one being lung capacity. The Wellesley woman, you see, starts with a larger weight, a larger height or length in general, or about the same; when it comes to girths, you see the girth of head and neck are appreciably above; while in chest measurements she falls below. Now when it comes to arm measurements, again, she is appreciably higher, until you strike the forearm record (which represents, you understand, anatomically, considerable hand-work in muscular development), where, again, she falls sadly below. In leg measurements in general, her record is slightly above, and also in breadths through the zone on the line or below, except in breadth of head, where we seem to have a peculiarity in type: that is, the Eastern head (if you will let me express it so) being longer and thinner—a cutter-built, instead of a sloop-built, affair. Now in depths you see the Wellesley woman has a very decided advantage; while in lung capacity she drops below.

I will not spend time further to analyze the Oberlin measurements on that chart.

On this other chart, these variations here are by single percental groups: that is, this being the average or 50 per cent. line and this being 49 per cent., 41 per cent., down to 41; and, going the other way, 49, 41 up to 30; that is broad enough to include all the variations; while on this chart we have the regular percental chart in form: that is, a 50 per cent. chart grading off by 5 per cent. gradations on the one per cent. limit at either side—this representing small measurements: then here is the limit representing larger ones. This, then, is the Wellesley chart, on which I have plotted the measurements of Nebraska women in red and the Oberlin women in blue; and this brings out the contrast in a much more striking way. That is, these other comparatively slight variations are, as it were, amplified when we take one chart as the standard which represents a fairly high development in size. Here you notice that both the Oberlin and Nebraska women start in weight at a point considerably below; that is falling, at a point between the 30 per cent. and 35 per cent. grade, below on the Wellesley chart: then they pass upward until the Nebraska women have a comparatively long trunk: that is, the sitting plot is high. Among the Oberlin women this is not the case.

Passing on to girths, we find that the girth of head and neck is smaller in both the Nebraska and Oberlin women than it is in the Wellesley; though in chest girths they both exceed by a great deal: that is, the Eastern type has not so good a chest development; and these other variations being for limbs, for breadths, for depths and for lung capacities.

We notice, first, that the Wellesley woman is taller and heavier than the typical woman of either of the Western groups; while the Oberlin and Nebraska women are about the same size and weight. The increased frequency of the Teutonic element in the Western group probably accounts for the taller height, sitting, in the Western than in the Eastern group, the Eastern type betraying more of the long-limbed and short-trunked type, which seems to be a characteristic of the tendency in modern development. The similarity in the length of the upper extremities is remarkable, although there is a tendency to a greater foot length in the Eastern system than common.

In girths, we notice, first, the record of the head circumference, which seems to be larger in the Eastern group; and this larger girth of head is accompanied by a larger girth of neck, the neck having to support the larger mass; although all the chest measurements are found to be considerably below the standard set by either of the Western colleges. This poor development of the chest is in an important region of the body and would seem to indicate less vitality, and certainly less working power. They also fall below in girth of hips, while the waist girth is about the same. In girth of upper arm the Eastern groups excel, while in girth of forearm they are markedly deficient. This, I think, may be explained: The Western type has been more accustomed to physical work, which would tend

* An address delivered December 27, 1899, at the Psychological Laboratory of Yale University, by Prof. Jay W. Seaver, Associate Director of Gymnasium, Yale University, before the Winter Meeting of Section H, Anthropology, of the American Association for the Advancement of Science.

to reduce the fatty tissue in the upper arm. This would seem to be established by the larger lung measurements found in the Western group, as this is a region that readily lends itself to the storage of fatty tissue, and the larger calf would show a tendency to insufficiency of exercise in walking.

In breadths, we notice the contour of the head is different in the various groups. We would naturally expect the largest head breadth to be found in here where the head girth is largest. The breadth of shoulder seems to be the same in all groups, although the broader neck is found where the larger head is to be supported, etc. In breadth of waist the Oberlin group seems to be markedly deficient, and for this I can offer no explanation. In depths, the Eastern group leads, showing a rounder type of figure; and the Oberlin group seems to be notably deficient in this regard. I can only hazard the opinion that this may be due to the farm life that has moulded so large a percentage in this group, and that this influence is obliterated, to some extent, by the Teutonic element in the far Western group, which I have spoken of as also being largely a class drawn from out-door life. At least, we may judge that the chest type is due to some influence outside of the college life, or to the different forms of physical training that are in vogue in the different institutions.

Finally, it is of great interest to notice that the Nebraska woman has much larger lung capacity, as she has much larger chest girths. Here you see is her limit, up at the 30 per cent. line, above; that is, there are 70 per cent. of the Wellesley students who have a smaller lung capacity than the average Nebraska woman; and you see Oberlin is deficient, even as compared with Wellesley, in that respect. It points to some error of college life, or some error in hygiene before college age has been reached. In this regard the Eastern college seems to have a better record than would be anticipated from the girth, the girths of chest being especially small in the Wellesley group; and it seems to be a fact, derived from a tabulation by Dr. Hanna of the measurements of the Oberlin students who had taken systematic exercise, that this element partly increases, and that the Oberlin student should stand next to the Nebraska student in this particular.

There is, then, to be found marked variation of physical form in the women of different localities, which might have been anticipated from the observations that were made on the male types from the different States by Dr. Gold, as shown in the report of the Sanitary Commission, at the close of the Civil War. We may believe, then, that comparatively slight causes may influence the hereditary limitations of growth.

CONTEMPORARY ELECTRICAL SCIENCE.*

DIELECTRIC STRENGTH.—The dielectric strength of a medium is measured by the fall of a potential per unit of length along the lines of electric force which the medium will stand without breaking down and allowing a spark to pass. The minimum of dielectric strength lies at a pressure of about 0·7 mm. in hydrogen, 0·3 in air, and about the same in carbonic acid. In hydrogen the minimum strength is 233 volts per cm., in air 300, and in carbonic acid 378. The measurements are taken, according to E. Bouty, in a field between two plane and parallel electrodes. This gets rid of brush and glow discharges. When the variation of the dielectric strength with the pressure is studied, it is seen that, apart from the lowest pressures, the dielectric strength varies with the pressure in a lineal manner. If y is the dielectric strength and p the pressure, the relation between the two is expressed by the formulæ

$y = 1·4 + 63·33 \quad p$ in hydrogen.
$y = 1·593 + 119·09 \quad p$ in air.
$y = 1·703 + 144·4 \quad p$ in carbonic acid.

The constant term denotes no doubt the part played by the electrodes in opposing the passage of an electric discharge. The above values are those found for glass, whereas much higher ones were found by Max Wolf for brass. Wolf's direct relation between the coefficient of p and the inverse mean free path is correct as between hydrogen and air, but only very roughly so in the case of CO_2.—E. Bouty, Comptes Rendus, August 20 and 27, 1900.

METASTABILITY OF WESTON CELL.—E. Cohen has found an important flaw in the perfection of the cadmium cell as a standard of E.M.F. Not only can cadmium sulphate in the form used, viz., $CdSO_4 + 8/3\,H_2O$, exist in two modifications below 15°, but the cadmium amalgam itself is unstable, and can exist in two modifications below 23°. The amalgam contains 14·3 per cent. of cadmium. At 0° a potential difference of 5 millivolts exists between the two modifications of the cadmium amalgam, and that difference is, of course, large enough to destroy the suitability of the cell as a standard of E.M.F. The fault is found both in the cells of the Reichsanstalt and of the European Weston Electrical Instrument Company. The passage from one modification to the other is apparently quite spontaneous. Above 23° there is, of course, no danger, but then a constant temperature cannot be insured without the use of a thermostat, and the supposed advantages of the Weston cell, derived from its surprisingly low temperature coefficient, are thus rendered illusory. No doubt a similar instability exists in the Clark cell, and it is only by a careful study of the behavior of the various cadmium amalgams and compounds that any improvement can be attained. Such a study is now being pursued in Amsterdam.—E. Cohen, Proc. Akad. Amsterdam, August 28, 1900.

CONDUCTIVITY OF PRESSED POWDERS.—The distinction between metallic and electrolytic conduction is chiefly based upon the temperature coefficient of the resistance. If the resistance increases with the temperature, the conduction is metallic. If it decreases, the conduction is electrolytic. Conductors belonging to both classes, or to an intermediate class, have not hitherto been obtained. But F. Streintz has made some experiments on powdered conductors which indicate something like a transition from one class to the other. He prepared fine powders of platinum black, graphite, and lamp black, and subjected them to considerable pressure in a hole bored in a block of ebonite, at the same time determining their resistance by auxiliary electrodes inserted in the block. The resistance of 1 mm. of platinum black having a section 1 mm. square was found to be 0·92 ohm at zero, as against 0·14 for ordinary metallic platinum. But the temperature coefficient of platinum black is only half that of platinum. Lamp black under the same conditions showed a resistance of 40,000 ohms, and a negative temperature coefficient amounting to the enormous value of 1 per cent. for 1° C. The column of lamp black is therefore equivalent to a dilute solution of sulphuric acid. Graphite, on the other hand, showed a resistance of only 21·9 ohms, and had a positive temperature coefficient. It therefore ranges itself among the metals in this respect. To complete the electrolytic character of lamp black, some kind of ionization and consequent polarization remains to be established.—F. Streintz, Ann. der Physik, No. 9, 1900.

MAGNETIZATION OF ELECTROLYTIC IRON.—Electrolytic iron has hitherto been studied after its formation. C. Maurain has, however, conceived the idea of investigating its magnetic properties in the act of deposition, and depositing it under the influence of magnetic fields of various intensities. The deposits were obtained from a solution of ferrous sulphate in sodium pyrophosphate, and were very brilliant and adhesive. The brass electrodes were mounted in the center of the magnetizing coil itself. It was found that the magnetometer deflection produced by the deposit increased in a linear with the time. Since the current was steady, this means that the magnetic susceptibility of the bottom layers of the deposit remained the same as that of the top layer. The magnetization also increased with the magnetizing force, and in that respect the deposit showed no difference from a deposit magnetized after deposition. But a quantity not hitherto fully appreciated is the high coercive force and residual magnetism of these deposits. There is practically no loss of magnetization after the removal of the field. It even resists an opposite field, when the latter is not too strong. But when the opposite field attains a certain strength, say 20 units, the collapse of the magnetization is sudden and complete. Nickel similarly deposited, though showing the same remnant magnetism, exhibits a gradual diminution of magnetism with an increasing demagnetizing force.—C. Maurain, Comptes Rendus, August 13, 1900.

MECHANICAL ACTION OF CATHODE RAYS.—Experimental determinations of the force exerted by cathode rays upon light movable bodies are as yet lacking, though Riecke has estimated the force acting upon a cathode shaped like a propeller. If the force thus found is regarded as that due to the reaction of projected particles, an amount of energy results which surpasses the whole energy of the cathode rays. It is, therefore, not permissible to deduce the kinetic energy of the cathode particles from such experiments. H. Starke has adopted a different arrangement. He used a cathode with a number of plates resembling a propeller. But the cathode was kept fixed, and the cathode rays impinged at an angle of 45° upon a thin plate of aluminium suspended above the cathode by means of a thin platinum wire. The results were almost all negative. An influence machine gave nothing but irregular disturbances, probably due to electrical forces unconnected with the impact of cathode rays. An influence machine of 20 plates, yielding a discharge potential of 10,000 volts, and a current intensity of 10^{-7} amperes, gave something like an appreciable deflection, which indicated, however, that the force to be measured is below 10^{-4} dynes. The experiments are to be continued.—H. Starke, Ann. der Physik, No. 9, 1900.

PROTECTION OF MAGNETIC OBSERVATORIES.—The new electric tramway between Vincennes and Nogent-sur-Marne, which passes at a distance of 3,000 yards from the Parc Saint Maur magnetic observatory, disturbs the needles at the latter to a very appreciable extent, the greatest disturbances being due to the electrical events attending the starting of the cars. Fortunately, these disturbances are symmetrical to the natural curve, and are of a much greater frequency than the natural fluctuations of the earth's magnetism. They can, therefore, be made practically negligible by employing needles of square or rectangular section, strongly magnetized, by increasing the moment of inertia of the swinging system by means of a piece of copper, and by damping with copper disks. This has been done by T. Moureaux with a declinometer and a bifilar magnetometer, for which bars 5 cm. long and 5 mm. thick were chosen, with a magnetic intensity of 200 units. The ordinary bifilar showed oscillations amounting to 0·0002 C. G. S. unit, but these disappeared almost completely on the new bifilar. A bifilar put up in the Fort de Nogent, within 300 yards of the tramway, showed disturbances of 0·0003 unit, which were, however, reduced to one-tenth of that amount in the new instrument. The only effect of the vagrant currents was a slight thickening of the curve traced by the magnetograph.—T. Moureaux, Comptes Rendus, July 30, 1900.

EFFECT OF TEMPERATURE UPON MAGNETISM.—According to Ewing, the magnetizing process of magnetic metals may be divided into three stages. During the first stage the permeability is small, and there is practically no retentiveness. In the second stage the curve of magnetization rises rapidly, and the permeability is high. In the third stage the permeability decreases and the specimen approaches saturation. The effect of heat is regarded as making the transition from one stage to another occur at lower values of the magnetizing force, owing to the vibrations set up and the weakening of the inter-molecular forces. R. L. Wills has investigated the effect of heat on the magnetic properties of certain alloys of iron which at the ordinary temperature had been previously found to give very different magnetic results when in different physical conditions. In wrought iron the permeability increases slightly as the temperature is raised to about 500°. With fairly strong fields, such that the third stage of the magnetizing process is brought on before any heat is applied, there is no appreciable increase in permeability as the temperature rises. But in an alloy containing 2·6 per cent. of aluminium there is not only no increase, but a decrease as the temperature is raised from 360° to 489°. This confirms the impression as to the exceptional character of the influence of aluminium upon iron.—R. L. Wills, Phil. Mag., July, 1900.

URANIUM RAYS.—H. Becquerel has not yet succeeded in obtaining "inactive" uranium. When uranium chloride is mixed with barium chloride, and the barium is precipitated as sulphate, the latter takes down with it the greater part of the radio-activity of the uranium. The question remains as to whether a further application of the same process would eventually result in the uranium being made entirely inactive. Becquerel has therefore applied the same process eighteen times over to the same specimen. He found that the barium sulphate precipitated was less and less active, and that correspondingly the loss of activity of the uranium became less and less in proportion to its initial activity. Between the eighth and twelfth operation the variations in activity were sometimes positive and sometimes negative, and could possibly be due to the presence of more or less water, as the salt is hygroscopic. In the case of the unpurified product, aluminium is more transparent for the rays than glass, but the case is reversed in the purified uranium, whose rays obey rather the rules of light than those of Roentgen rays in the matter of absorption. After the fifteenth operation, another decided diminution of activity sets in, bringing it down to one-sixth of the original activity. What happens after the eighteenth operation is not yet known.—H. Becquerel, Comptes Rendus, July 16, 1900.

DETERIORATION OF CABLES.—When a cable is used for transmitting a variable current, characterized by equal fluxes of opposite electricity, it preserves all its electric and organic properties intact. When, however, the current traverses it always in the same direction, the cable, according to G. Rheins, passes through four stages marked by the complete loss of some electric property, and the change of the properties remaining. The order of disappearance is the following: Inductance, capacity, insulation, conductivity. This process of deterioration is due to the slow penetration of the metal of the core into the dielectric, and this penetration appears to be independent of the kind of dielectric, since it is observed both in the case of paper and of gutta-percha. In one case of the latter, used for 20 years, the core was found to have soaked through to the surface of the insulator. In another case, that of a paper cable in use for four years, the copper was found to have penetrated into the first layer of paper, but not into the second.—G. Rheins, Comptes Rendus, September 10, 1900.

RESISTANCE OF BISMUTH.—W. Eichhorn has carried out some interesting investigations of the speed with which bismuth assumes a certain resistance under the influence of a magnetic field. He mounted a bismuth coil on a revolving disk so that at a certain point it passed through a magnetic field. Its instantaneous resistance was measured by means of contact pieces attached to the disk, and the resistances shown at various points when entering or leaving the field were compared with the resistances shown at the same points in a state of rest. Any lag or hysteresis of the resistance would then show itself as a difference of resistance for corresponding points, according to the state of rest or motion. The rate of revolution was 1,000 per minute. A well-marked difference was observed both on entering and leaving the field. On leaving the field the resistance remained too high. This result is specially conclusive. For in the state of rest the resistance was influenced by the heat of magnetizing current, which tended to exaggerate the normal resistance. That the resistance when in motion is still greater shows that the bismuth does not instantaneously lose the high resistance acquired in the maximum field. The difference is constant for any speed of revolution exceeding 500 per minute, but below that rate it increases with the speed. The author calls the phenomenon a viscous hysteresis of resistance.—W. Eichhorn, Ann. der Physik, No. 9, 1900.

ATMOSPHERIC POTENTIAL DURING A SOLAR ECLIPSE.—The modern theory of ionization, or rather of "electronization," has been applied with considerable success to the explanation of atmospheric electricity. Elster and Geitel suppose that the impact of the ultra-violet rays of the sun upon the upper strata of the atmosphere produces the separation of positive and negative electrons, and that the different velocities of the latter produce an unequal distribution of positive and negative charges in the atmosphere. If that is true, then a temporary cessation of the sun's activity in this respect might produce a well-marked change in atmospheric potential. Such a change was searched for at Pavia by E. Oddone during the total eclipse of the sun on May 28. Unfortunately, the geophysical observatory at Pavia was not in the path of totality, but 8-10nths of the disk were obscured, and a measurable effect could therefore be hoped for. The measurements, taken with a water-dropping collector and Exner electroscope, showed a slight increase of positive potential, but it was difficult to dissociate this effect from the effect of moisture. Perhaps some observations hitherto unpublished were taken within the area of totality. In any case, the chances are that the effect of a change in the upper atmosphere would not be felt for some time at the earth's surface.—E. Oddone, Rendic. Ist. Lombardo, 33, 1900.

German Private Claims Against China.—Vice and Acting Consul-General Hanauer sends the following from Frankfort, September 11, 1900:

The German central bureau for the preparation of commercial treaties, which has had many inquiries from German firms and individuals who have suffered loss in China, has issued a circular which says:

"All such claims should as soon as possible be sent into the law division of the Imperial Ministry of Foreign Affairs and contain in writing the following points: A minute description of the location of the property (building, vessel, store, shop or depot) when damage or loss occurred. Description of the actual occurrence of the destruction or damage. Statements of any parties who have been actual witnesses. A careful estimate of the damage sustained, and a detailed description of the property. Attestation of the above by the nearest German consulate in China."

As consuls in China have judicial powers, it is expected their attestation will be accepted by the Chinese authorities as proof of the correctness of the claims.

* Compiled by E. E. Fournier d'Albe in The Electrician.

THE CRYOLITE OF GREENLAND.*

IN 1850 the Danish government held, in Copenhagen, an exhibition of Eskimo tools and products from their distant colony in Greenland. Among the implements shown were a number of stone sinkers, which the natives had used for their nets, some of which sinkers were made from a white, translucent mineral. Dr. Hartman, a scientist, noticed these, and having secured a specimen, analyzed it and found it to be the rare and valuable mineral cryolite.

During the following year the Danish government made investigations, and discovered a large deposit near Ivigtuk, on the west coast of Greenland, in latitude 62° 10′. Strangely enough, the Eskimos had chosen the ground above the deposit for a fishing village, and the fact that they used blocks of cryolite for the foundations of their tents probably led to its discovery. Fourteen years later, Dr. Julius Thompson commenced mining, and the industry has steadily grown in importance ever since.

In the early days of the cryolite industry, the greater part of the output was used for the production of aluminium. Bauxite soon supplied it in that line, and then it was found that from no other material could alum and sodium carbonate be made so cheaply and so pure. The Pennsylvania Salt Company accordingly contracted for the whole output for that purpose, and mining on a large scale began. About this time some experiments were made with cryolite in the endeavor to make from it a transparent glass. They failed, but a beautiful opaque porcelain-like substance was the result; far cheaper than and as beautiful as china. By merely melting a mixture of cryolite, sand, and zinc oxide, this material is formed, and ware of any desired shape can be stamped from it. It is so tough that cups and plates made from it can be thrown down violently without breaking.

Very lately cryolite has been used once more in the manufacture of aluminium. By means of a powerful current it is melted, and the corundum, Al_2O_3, which forms the source of the metal, is dissolved and decomposed within it.

It can be easily seen how great an economic value cryolite possesses and of what importance it is in the arts; and as the Greenland deposit is the only one in the world at which it occurs in workable quantities, the Ivigtuk mines have naturally become of great importance.

Arlssuk Fiord, which leads from the ocean to the mines, is a narrow strait between snow-covered granite mountains. The inland ice reaches almost to it, and bergs and pack ice close it to navigation for nine months of the year. It is so deep that vessels in the harbor can fasten their bows to the rocky walls and get no soundings from the stern.

The cryolite occurs in a great vein of arey gneiss, penetrating the granite. The form of the deposit is rather peculiar. It is neither a dike nor a stratum, but seems to be an immense bed, possibly great veins, penetrating the gneiss at an angle of about 45°, and extending far below sea level. The deposit consists of two parts. First, an inner bed or vein, about 500 by 1,000 feet in section, containing nearly pure cryolite. It is from this vein that most of the cryolite is obtained. Whole shipments have been taken out at a depth of about 100 feet, averaging 99½ per cent. of the pure mineral. The cryolite of this vein was reported, before the mine had been much worked, to be white only for ten or fifteen feet from the surface, and many theories were presented to account for the fact, one of which claimed that two intruding dikes, on either side of the vein, had by their heat bleached out the cryolite between. The labor was in vain, for the pit has now been sunk over 100 feet, and the cryolite grows whiter and purer as the mines increase in depth.

The limits of this vein are generally very sharply defined. Surrounding it is another peripheral bed, which gradually merges into the gneiss. The cryolite here is not nearly so pure as that of the central portion, and with it occur the most important ores and minerals of the mine, as well as the various compounds resulting from the alteration of the cryolite.

Between these two veins there is sometimes an intermediate portion, in which the cryolite seems to act as a matrix to the minerals of the outer zone, instead of forming the mass.

The mines are all open workings and have been carried far below the water line. If the pits should be left unprotected during the long winters, the water and snow would soon fill them, and by spring there would be thousands of tons of ice to remove. This difficulty is overcome in a simple but ingenious manner. At the end of the working season the mines are flooded, and the little lake thus formed freezes over, and ice is formed of a thickness never exceeding five feet. When warm weather comes again, it is only necessary to pump out the pits, clear away the little ice which remains, and start to work again.

The product of the mines, amounting to many thousands of tons a year, is all shipped to the contractors by means of a small fleet, which plies between Philadelphia and Ivigtuk. Even in the middle of summer the ocean near the Greenland shores is full of icebergs, and navigation is difficult and dangerous. It happens every few years that some unfortunate vessel, delayed by adverse winds at Ivigtuk, is caught in the pack ice and forced either to return to the mines or winter in the ice.

As a mineral, cryolite is notable as being one of the few fluorine compounds found in nature. It is a fluoride of sodium and aluminium, with the formula $AlF_3 + 3NaF$; specific gravity of 2·95 to 2·96, and hardness of 2·5 in Dana's scale. It crystallizes in the monoclinic system, the crystals generally simple, but sometimes very complicated. The pure mineral is subtranslucent and has a peculiar property of increasing in transparency when wet. At Ivigtuk the crystals are found in cavities within the mass. They are usually small, and well-formed specimens are very rare. Cryolite has been found at only three places, Ivigtuk, the Urals, and the base of Pike's Peak, in Colorado.

The inner bed of the Greenland mine contains several very interesting minerals which have resulted directly from the alteration of the cryolite. Of these, the commonest and most important is pachnolite, a fluoride in which some of the sodium of cryolite has been replaced by calcium.

* H. S. Canby, in the Yale Scientific Monthly.

THE Scientific American Supplement.

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